DRAFT

Cruise Report
Chief Scientist Training Cruise

2 – 17 December 2016
Honolulu to San Diego

onboard RV Sikuliaq
Cruise # SKQ201616T
NSF Award #1638164

Chief Scientists
Bernard Coakley – University of Alaska
Robert Pockalny – University of Rhode Island

DRAFT

Table of Contents

Introduction

The graduate school experience is made up largely of reading, set-piece exercises, passing exams and research. While most students participate in collecting the data they will reduce and interpret for their degrees, many do not have the opportunity to see their work in the larger frame of the science process, which includes planning and fund raising. This training cruise was designed to give these students practical experience, augmented by presentations by the PIs, in selecting a problem, defining a hypothesis and planning and executing a cruise to test their hypotheses.

This cruise exploited a planned transit of the Sikuliaq to train MGG students in scientific leadership. Leadership can be expressed through the identification a significant scientific problem that can be solved with the resources at hand. Leadership can also be found in cruise planning and operation. Empowering junior scientists for leadership at sea has been the single objective for this cruise.

All projects are resource-limited. There is finite money and time. Hull-mounted equipment on a particular vessel will be adequate for some purposes, but not for others. Picking a way through the maze of alternate possibilities to gain funding, identify the necessary instrumentation and successfully execute a cruise plan is a requirement for success as an MGG PI. Graduate students do not routinely receive training and mentorship in these skills. This cruise was planned to fill that gap and supplement graduate education.

The process for this project attempted, as much as was possible, to emulate the process for MGG science. There is an application for resources, based on a scientific hypothesis and a practical work plan. There is pre-cruise planning. There is in-port work to be done. There is watch standing and data processing and analysis while underway. Then there is reporting.

Given that there was already assigned ship time, the students did not submit budgets, but rather argued for uses of the ship during the allotted time. Cruise planning was a collective effort, harnessing the input of 22 aspiring chief scientists to define a set of sequential projects that could be serviced along the transit track. Lecture time was used to highlight differences from real world programs and planning and prepare students by introducing them to the mechanics of writing a complete proposal with ship time requests and budgets.

To accomplish this, the students have had to understand and work within the limits imposed by the on-board equipment installed on the RV Sikuliaq and the ship's planned transit track from Honolulu to San Diego. In addition to the transit time, six additional days were added to the ship's time to permit the execution of small surveys and sampling en route.

To achieve our objectives, it was necessary to identify a problem, research the problem in the literature and with existing data, identify a hypothesis and plan a test of the hypothesis that can be executed in the available time with existing (more or less) equipment on a ship. We did this through a set of lectures and discussions in Honolulu and on board. This process resulted in a ship track (Figure 1) and set of objectives that we met and at times exceeded during our time on board.

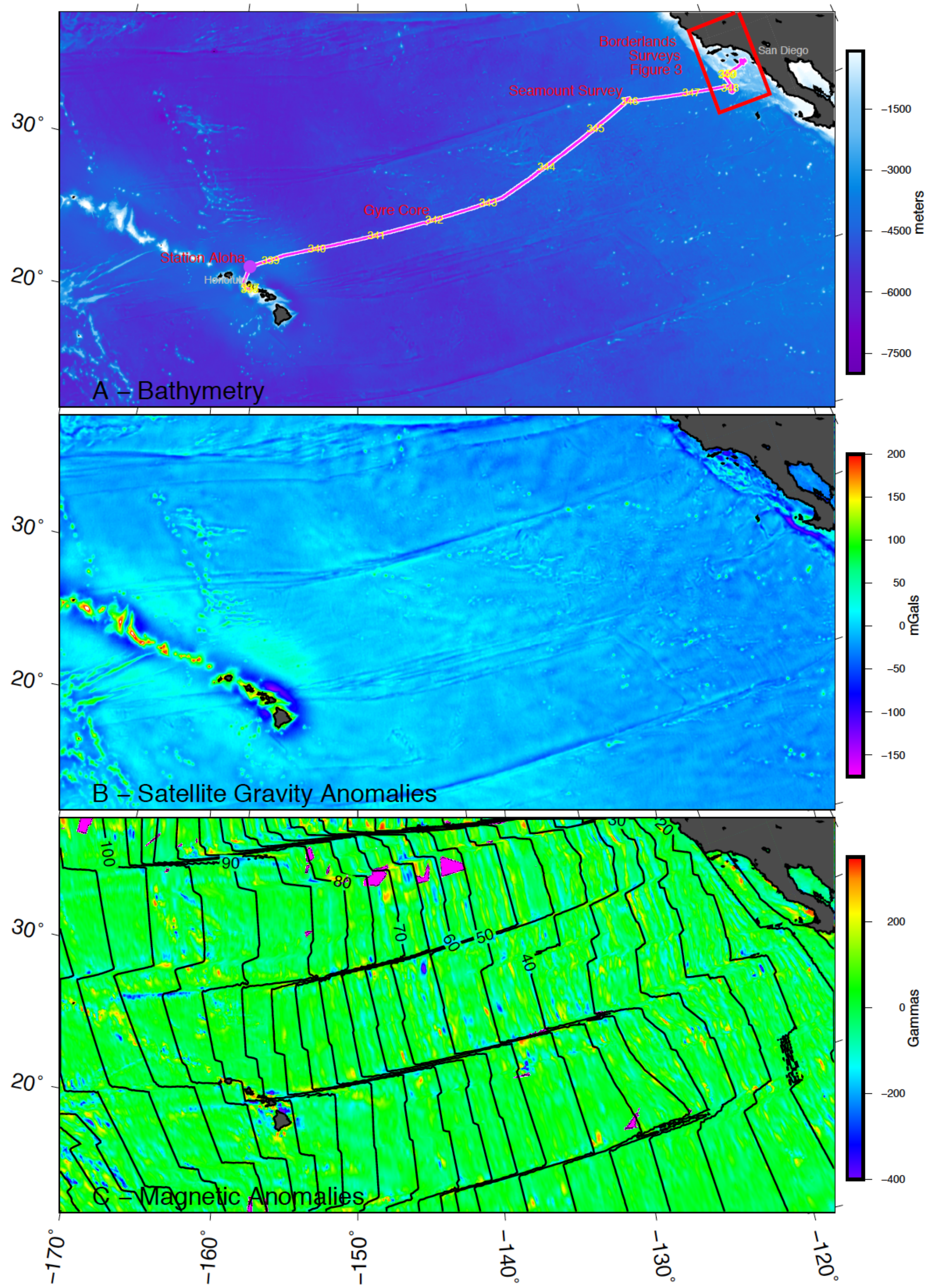


Figure 1- Gridded data from the three basic data sets for Marine Geology and Geophysics. The ship track, as sailed and project locations are shown over the bathymetry on 1a. The start of each day is indicated by yellow day numbers. Figure 1a shows GEBCO bathymetry [GEBCO 2014]. Figure 1b shows the Sandwell and Smith satellite gravity anomaly data [version 23.1; Sandwell et al., 2013]. Figure 1c shows the EMAG2 [version 2; Meyer et al. 2016] magnetic anomaly grid. Superimposed on this are Mueller's age picks from his global grid of seafloor ages [Muller et al., 2008]. These data were used to discuss possible surveys at the coarsest scale.

Group Meetings in Honolulu

Most of the students (see Appendix A) arrived on Monday 28 November (Appendix A). Each group was met at the airport and driven to the New Otani Hotel in Wakiki. They were free that day to do as they wished. Groups meeting began on 29 November and continued through the next day. The Hawai'i Institute of Geophysics hosted these meetings, which were a combination of lectures and group discussions on the objectives for the cruise. Given the widely varying experience level of the different participants, giving them all a common basis for understanding life at sea and the scientific opportunities of this cruise was essential to the discussions that followed (see Agenda Appendix B).

On the first day, the participants were given an overview of the planned program. Shortly after this presentation, they all took a pre-cruise survey, which offered them the opportunity to self assess their experience and confidence level in approaching NSF, proposals and proposal writing. Subsequent presentations focused on data mining with GeoMapApp, the capabilities of the RV Sikuliaq and the scientific opportunities afforded by the planned ship track. These discussions and presentations continued into the 2nd day, followed by the first discussions of the scientific possibilities of the cruise track.

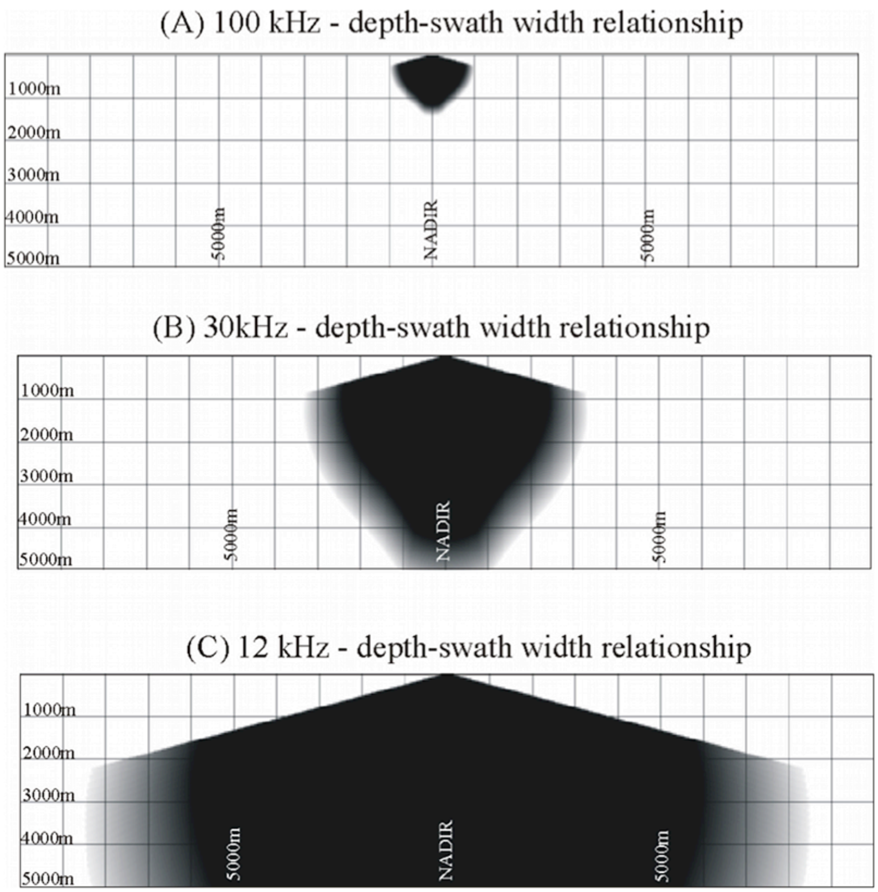


Figure 2 – Kongsberg swath width versus depth to different frequency swath mapping sonars. Installed on the RV Sikuliaq are an EM 302 (30 kHz) and an EM 710 (100 kHz).

Constraints on Ship Track Planning

While the gridded data sets (Figure 1) were useful to begin the planning process, higher resolution data are necessary to plan a cruise. These data, collected from the NGDC archive with GeoMapApp, help identify interesting hypotheses and were used to leverage the data collected from Sikuliaq into a larger data set. At a minimum, these data indicated gaps in the existing data set to route the ship's transit track to avoid collecting redundant data.

The existing data and literature were the sources for planning the cruise. This work, like any science cruise, built on previous work, which was used to frame the hypotheses or ask the next question to advance understanding.

RV Sikuliaq Capabilities

The ship's equipment imposes constraints on the science that can be accomplished. While Sikuliaq has a fairly typical array of hull-mounted sonars and a gravimeter to collect underway data, the particular pieces of equipment restrict where useful data can be acquired. These systems are;

- Bell BGM-3 underway Marine Gravimeter
- Knudsen 3260 – 12 kHz precision depth sounder – not working
- TOPAS 18 sub-bottom profiler – steered beam chirp sub-bottom sounder
- Kongsberg/Simrad EK60 Split Beam Sonar Array – 18 kHz, 38 kHz, 70 kHz, 120 kHz and 200 kHz
- EM 302 swath mapping system – 30 kHz, 0.5˚ x 1.0˚ resolution
- EM 710 swath mapping system – 70-100 kHz, 0.5˚ x 1.0˚ resolution

While the BGM-3 and TOPAS 18 can collect useful data everywhere in the ocean, the frequency of the swath systems restricts the EM 710 to relatively shallow water (< 1000 meters). The EM 302 will collect data down to 3000 meters or more (Figure 3), but at the expense of reduced swath width (Figure 3). Along much of the track, the seafloor is near or beneath 5000 meters (Figure 4), so this was quite restrictive in the selection of the problem that could be addressed with bathymetry data. The participants had the choice between a restricted swath width in deep water or full swath width in relatively shallow water. Largely as a result, much of the scientific interest focused on the shallow water of the California Borderlands, near the end of the planned track (Figure 4)

Ship Track

While we attempted, as much as possible, to emulate the NSF process of proposing and evaluating the participant's ideas about how to use ship time, the whole exercise is somewhat backward compared to how one would proceed with an actual proposal. Here the possible survey locations are defined by the transit track, a great circle from Honolulu to San Diego (Figure 1). Planning the track was a matter of identifying opportunities en route. Typically an NSF proposal would select the problem to be addressed and then the location or select both simultaneously. While opportunism is can be an important constraint on the proposal process, it is not typically the primary constraint.

A subset of the participants were tasked with defining the ship's track based on the various proposals and apportioning the available survey time with respect to the ranking of the individual proposals. They produced a set of latitude, longitude way points, including distance between points, cumulative distance along track and estimated arrival time (Zulu) at the point. For proposed cores and CTD cast they estimated time on station. This planned track was the standard to assess the progress of the ship along track and to be adjusted as it fell behind or was consistently ahead of the projected arrival times.

Underway Operations

After moving onto the ship, the students were introduced to the various instruments and the basics of operation. Ship's party made presentations about life onboard and the particulars of the ship's data system.

Group Meetings on board RV Sikuliaq

Everyone moved onto the ship on Thursday 1 December. The first day was taken up with orientation to the ship and the ship's schedule, unpacking and getting settled on board. The RV Sikuliaq departed Honolulu at 13:00 (local) on Friday 2 December. Each day at 12:30 (local) there was a presentation (see Appendix C) on some aspect of ship's operations, ship instrumentation, NSF and writing proposals for NSF. These discussion (Figure 5) included how to access information through the NSF website, the UNOLS website, ship time request forms, budgeting for NSF proposals, the NSF proposal process and other building blocks for preparing a successful NSF proposal.

The remainder of the discussion was focused on defining the science objectives and ship track for the cruise. For this the participants reviewed the various options offered by the great circle track from Honolulu to San Diego and recognized the "penalty" in lost time for objectives well off that track.

We established in Honolulu that no one was interested in mapping around the islands. The area is pretty thoroughly mapped. It seemed there was not much we could add to the work that has already been done. For this reason and the depth limitations on the EM 302 swath mapping system, it seemed the most productive work could be done in the California Borderlands west of San Diego and south of Los Angeles (Figure 4)

The participants organized themselves into groups favoring particular objectives. Each group prepared a presentation to advocate for their objectives and some ship time for their planned survey and, in some cases, seafloor sampling with a gravity corer. Each presentation was critiqued at length. Questions probed the efficacy, necessity, utility and sensibility of the proposed work. The questions were sharp and focused, similar to those one might expect in a proposal review or panel meeting. Each project gained or lost credibility on the basis of the proponent's responses to the questions. After the questions were done, the participants were asked to rate the projects on the scale used for NSF proposals (E, VG, G, F, P). All of the projects were well regarded, but some received higher ranking. In the end, we were able to do all of the projects.

Underway days (December 2-17)

Each underway day was divided into three watches, one from 12 to 4, one from 4 to 8 and the last from 8 to 12. Each watch stood twice per day, in the AM and the PM. Watches were set prior to departure from Honolulu and kept until data acquisition was secured about an hour out of San Diego. Continuous watch standing supported continuous data acquisition.

Each watch had a "chief scientist" to lead it. The responsibility for real-time decision-making cycled through the students, ensuring each students was chief for at least one watch. The PIs also stood watches, but functioned as consultants.

The other students were assigned to an instrument for the watch. Each had responsibility for monitoring instrument function, ensuring the data were logged correctly or continuously processing the data collected during their watch. At the end of each watch, the watchstanders crossed over and report on current operations of the instruments and the data logged and processed during the previous 4 hours.

The noon change of the watch was one time everyone was together. This time was used for lectures (Appendix C) about how the instruments function, data reduction, the history and seafloor of the area we are transiting and other aspects of science at sea (e.g. data archival resources, proposal writing, etc.). There was one lecture per day.

Station Alpha

Prior to sailing, we received a request to support water sampling at Station Alpha for an NSF PI Alyson Santoro, now at UC Santa Barbara. A day was added to the ship time allotted for this cruise, so this effort had no net impact on the training program.This visit was a repeat sample to build up a time series for this part of the ocean. At this spot, Sikuliaq executed two CTD casts to 1000m, collecting water for culturing microbes (bacteria and archaea) from the oligotrophic ocean.

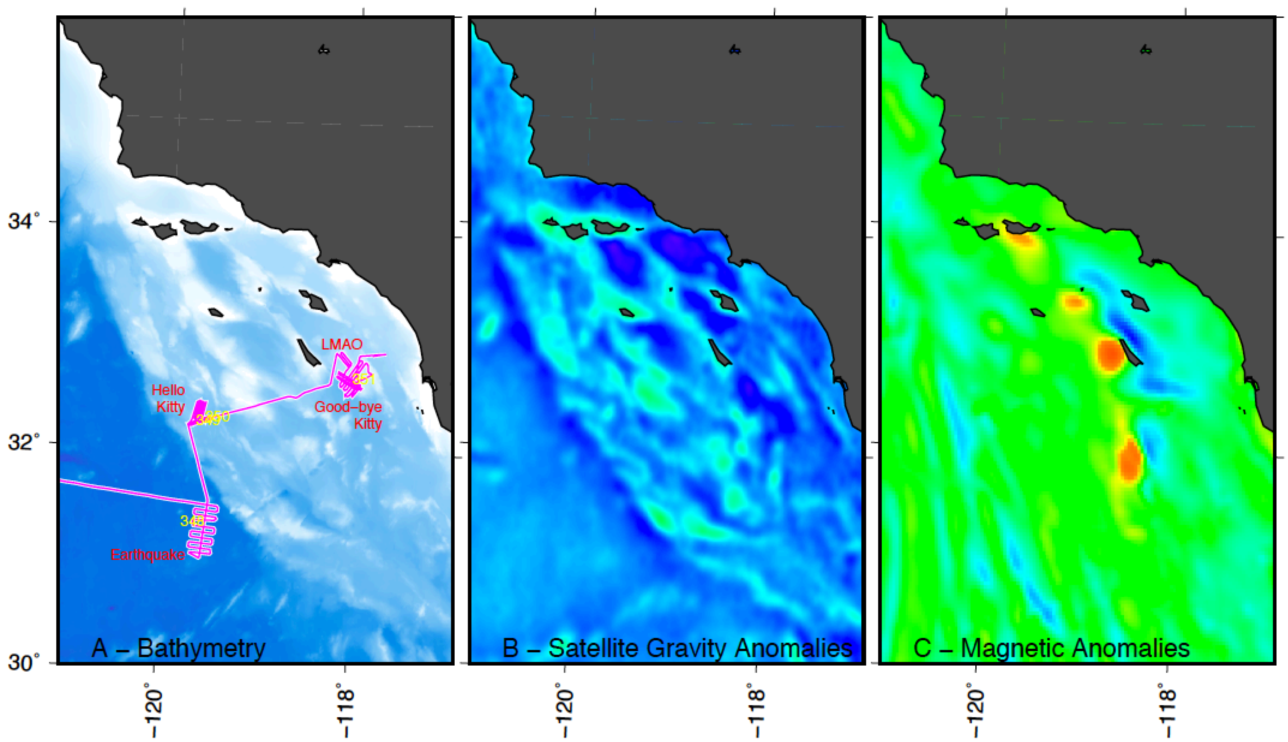


Figure 3– Borderlands detail figure Figure 5a shows GEBCO bathymetry [GEBCO 2014]. Figure 5b shows the Sandwell and Smith satellite gravity anomaly data [version 23.1; Sandwell et al., 2013]. Figure 5c shows the EMAG2 [version 2; Meyer et al. 2016] magnetic anomaly grid. Superimposed on this are Mueller's age picks from his global grid of seafloor ages [Muller et al., 2008]. Cruise days are annotated on Figure 5a in yellow.

Participant Proposed Science Projects

The participants planned projects, labeled in Figures 1 and 3 to take advantage of the ship track to access scientifically useful areas. Careful timing of the planned ship track, combined with realistic scheduling made it possible to execute all of the surveys proposed by the participants.

These proposals, which were circulated among all the participants, can be read as very succinct NSF proposals.

Gyre Core

The abyssal sediments in the North Pacific Gyre (NPG) accumulate in one of the lowest energy regions in the world. As a result electron donors (e.g., organic carbon) to support microbial populations are scarce in these muds. Oxygen penetrates 10s of meters into the NPG sediments, indicative of slow microbial respiration and growth [Røy et al., 2012]. The low sedimentation rate (~1 μm year^{-1}) and lack of organic carbon limit consumption of oxygen by aerobic microorganisms [Røy et al., 2012]. Although the sediments in this region are organic poor, the red clays are rich in iron oxides and silicates. The dissolution of these minerals could be an important source of ferrous iron [Fe(II)] that could support populations of autotrophic, aerobic iron-oxidizing bacteria. Radiolytic hydrogen is also a potential source of energy for lithotrophic organisms [Blair et al., 2007] in these sediments. Only one study [Walsh et al., 2016] has analyzed the microbial communities at the North Pacific Gyre at three depth intervals (0.05, 2, and 4 m), but the methods used could not distinguish organisms and metabolisms.

We hypothesize that aerobic, lithotrophic Fe(II) and H_2 oxidizing microorganisms are abundant in NPG sediments and may be an important source of organic carbon to heterotrophic microbes. We also hypothesize that the microbial communities present at the NPG are well adapted to their oligotrophic conditions, and these adaptations will be reflected in their genomes by a reduction in non-essential genes and result in overall smaller genome sizes among community members. We will utilize single-cell genomics and metagenomics to test these hypotheses, which will give us both taxonomic and metabolic identification of microbes important in NPG sediments. This study will shed light on the microbial metabolisms that support life in energy-limited sediments, and also allow us to understand the importance of aerobic carbon oxidation (i.e. remineralization) in oligotrophic sediments.

To meet these needs, a ~2 meter gravity core from the North Pacific Gyre was taken abroad the R/V Sikuliaq on transit from Honolulu, HI to San Diego, CA in December 2016. This deep (~5000 m) ocean region is poor in dissolved iron, which results in a low surface chlorophyll concentration, which will help us recognize a location to deploy the gravity corer. The core will be sampled at three depths (0.2, 1, and 1.5 m) to study different dissolved oxygen regimes of 150, 100, and 75 μM, respectively [Røy et al., 2012].

The results from this research will help us understand life in the low-energy subsurface, which covers a significant part of the ocean biosphere (42 % of the ocean) and collectively harbors ~10 % of the microbial cells in sediments [Kallmeyer et al., 2012]. Lithotrophic metabolisms may be more important and prevalent at oceanic gyres, and would change the prevailing view that microorganisms rely more on organic carbon in these systems. Although organic carbon remineralization is still important in this context, these data will help define the organic carbon fractions that microbes rely on in oligotrophic sediments, which will aid in future isolation of important community members. This project is interdisciplinary in nature, and will expose a diverse group of scientists at all career stages abroad the R/V Sikuliaq to view marine sediments from a biogeochemical perspective, one that they might not think about otherwise. These different views make the proposed research stronger than viewing it from a single, subjective disciplinary-centric position.

Methods

Approximately 0.5 g (wet weight) samples (in triplicate) from each depth interval for single cell genomics will be immediately preserved in 0.5 mL of 10 % glycerol-Tris-EDTA solution in 2 mL cryovials and frozen at -80 °C. The sample weight of 0.5 g should equate to ~10^5-10^6 cell $gram^{-1}$ [Kallmeyer et al., 2012], which should be sufficient to avoid contamination from several sources including the overlying water upon gravity core retrieval, the steel casing of the gravity corer, and also laboratory and human contamination.

Laboratory and human contamination will be addressed by creating 2 mL cryovial blanks, which will be uncapped during core processing and 0.5 mL of 10 % glycerol-Tris-EDTA solution will be added and frozen. Metagenomic samples will be approximately 10 g of wet sediment at the above depths, which will equate to 10^6-10^7 total cells for DNA extraction. The samples were shipped to Bigelow Laboratory for Ocean Sciences on dry ice upon arrival at San Diego on 17 December 2016. An initial 16S rRNA gene survey will be conducted on the metagenomic samples to determine the community composition with respect to depth to identify population changes with changes in oxygen regimes. This will be done at Integrated Microbiome Resource (Dalhousie University, Halifax, Nova Scotia) using the universal bacterial and archaeal primers 515F-926R, which amplify the V4-V5 hypervariable region of the 16S rRNA gene. Live samples will also be collected for culturing iron-oxidizing bacteria in vacuum bags.

Pore waters were extracted from the above sampling depths with Rhizons (Rhizosphere Research, Waeningen, Netherlands) from the extruded core and analyzed for Fe(II) via the Ferrozine method [Stookey, 1970]. Iron analysis is sensitive to the oxygen concentration, so an extruded core may cause underestimation of iron (if present at all). However, this will probably not be an issue because the time scale of iron loss by reaction with oxygen will be slower than the extraction with Rhizons and later reaction with Ferrozine. A subset of the extracted pore waters will be frozen and analyzed by ICP-MS at Bigelow Laboratory for Ocean Sciences (BLOS), which will also give us a suite of other important sedimentary elements (e.g., S, Mn, P) as well as confirm concentrations of iron. Stable iron isotopes can track potential sources of iron in sediments [e.g., Homoky et al., 2013] and will be measured from NPG pore waters to determine whether the major iron source in pore waters is aeolian, continental, or hydrothermal in origin. Solid phase iron minerals will also be extracted by the sequential iron extraction procedure developed by Poulton and Canfield [2005] from 1 g of wet sediment at BLOS. The overall geochemical analysis will provide the contextual data for the microbial communities present.

Seamount survey

Seamounts are biological hotspots as many chemosynthetic communities live on seamount outcrops. They also cause upwelling and vertical mixing of ocean currents and hence provide nutrient rich environment for a variety of plant, animal, and microbial species. Older seamounts can be geo-hazard as they could cause large submarine landslides when flanks collapse due to magma extrusion and seeping [Staudigel and Clague, 2010]. Seamounts can also host ferromanganese crusts that contain nickel, cobalt and rare earth elements. Study of seamounts is important to understand the magmatism and tectonics of an area.

Study area, geological setting and previous studies:

The study area is located in the Pacific Ocean off California within relatively young oceanic crust of 33-25 Ma (Figure 1). A large seamount chain of volcanic origin is observed within this area. Fieberling tabletop seamount is the largest and oldest seamount in the Fieberling-Guadalupe seamount trail. Multibeam bathymetry data from the 80's indicate that the shallowest water depth on top of this seamount is ~450 m, surrounded by ~4500 m deep seafloor. Swath bathymetry data also indicate that the seamount is approximately circular with a diameter of ~40 km (and volume is ~2500 km^3). The seamount has steep flanks. It has a flat-top indicating that the seamount was once above sea-level, and since been eroded due to oceanic currents and weathering. The age of this seamount is approximately 20.3 Ma, which is ~10 Ma younger than the seafloor [Konter etal., 2009]. Previous studies from the Jasper seamount, located 530 km southeast of Fieberling seamount and part of the Fieberling-Guadalupe seamount trail, indicate non-uniform magnetization, increase in density with depth, lower seismic velocities associated with low-density and high-porosity material [Gee et al., 1988; Hildebrand et al., 1989; Hammer et al., 1991, 1994; Pringle et al., 1991]. According to Gee et al [1991], subsurface rocks of the Jasper seamount are divided into three groups: volcaniclastics at the summit, lavas of intermediate alkalinity at the flanks and the remaining deeper part consists of tholeiitic basalts.

Some oceanographic studies were carried out in the late 80's on Fieberling seamount, but very little geophysical, geochemical and geological information exists to provide an in-depth understanding of the tectonomagmatics of this volcanic seamount. Also, very little information is available about the sedimentary structure on top of the seamount and along the flanks.

Objectives

The present study focusses on understanding the evolution of the seamount by magmatism, deformation and sedimentation in this region. This study also aims to understand the rifting patterns on the seamount and underlying relationship with the nature of basement structures.

Survey design, data, methods and expected results

Survey plan consisted of two nearly perpendicular lines of approximately 45 km in length that cross the seamount linked by a transit line of ~40 km length that covers the eastern flank of the seamount. We used Kongsberg echo sounder systems (EM 302 with a frequency of 30 kHz and EM 710 with a frequency of 100 kHz) to obtain the high resolution image of the topography. The higher frequency system (100 kHz) provided detailed bathymetry for depths less than 1000 m, and the lower frequency system (30 kHz) images down to ~5000 m.

The swath width depended on the water depth, sector coverage, ping mode and transmitting frequency. As an example, for a water depth of 1000 m and sector coverage of 140 degrees, the swath width is 5500 m for the 30 kHz system. Additional constraints on the structure was obtained from side-scan and backscatter data. Shipboard BGM-3 marine gravity meter system was used to measure the gravity anomaly associated with the volcanic construct. Both the high resolution multibeam swath bathymetry data and shipborne gravimetric data will be used post-cruise to constrain the density structure of the seamount. The changes in subsurface rock density indicate nature of the subsurface rocks and the internal structure of the seamount.

Additional constrains on shallow subsurface sedimentary layering were obtained using the Kongsberg TOPAS PS-18 parametric CHIRP sub-bottom profiler. The frequency range of the chirp is 0.5-6 kHz, providing a maximum vertical resolution of ~0.2 ms. Chirp subsurface penetration depends on the bottom type, and provides high-resolution seismic data up to a maximum depth of ~150 m beneath the seafloor. Faults and fluid flow features can be imaged based on offset in reflector continuity within the shallow sediment section.

The combination of multibeam, sidescan, backscatter, gravity, sub-bottom profiler and coring results will be employed to constrain the tectonic processes and geomorphology of the Fieberling seamount, and so contribute to our understanding of tectonic and structural evolution of the seamount. These results can be extended to other seamounts in the region to understand the relationship between rifting and volcanism, and perhaps might be applicable to seamount chains from other geographic and tectonic settings.

Earthquake

The California Borderlands is an area of diverse tectonic activity where strike slip and normal faulting are common. In this region the continental and oceanic plate undergo oblique subduction leading to shear and high seismic activity. Historically, seismic activity was thought to only extend to the Patton Escarpment, yet in 2012 a 6.3 magnitude earthquake was located in the eastern Pacific plate west of the Patton Escarpment (31.08N, 119.61W). This brittle failure of the oceanic crust is suggestive of structural movement [Hauksson et al. 2014]. Indeed, ground shaking was reported along the southern California coast. The focal mechanism of the earthquake was identified as normal, while a 1982 earthquake (magnitude 5.2) was identified as having a strike-slip focal mechanism [Hauksson et al. 2013]. No evidence for a connection between the two events has yet to be identified, but we believe they may be structurally linked.

Research on the seismic activity beyond the Patton Escarpment has been lacking due to the generally held belief that this area was aseismic. The recent earthquake and its estimated location suggest that the location on the seismically active portion of the Pacific plate may extend farther out into the oceanic lithosphere.

Active processes in area

Previous studies have concluded that there may be ongoing pooling of magma under the crust. The cooling and subsequent accretion of this magma may cause localized loading and stress sufficient to power deep earthquakes in the region [Hauksson et al. 2014; Bowden et al. 2016]. Although the crust is 10-18 Ma in age, we believe that there exists a strong possibility that the earthquakes are a result of one of two alternative possibilities. First, extension of an existing fault in the oceanic lithosphere may have accommodated movement or an extinct fault existed and reactivated causing an earthquake [Hauksson et al. 2013].

Yakutat Block

The collision of the Yakutat Block with the northeastern Pacific subduction-transform corner [Koons et al. 2010] may provide an analog for the geodynamic interactions of the Borderlands region. As a microplate, the Yakutat Block experiences a variety of forces along its margins which results in strike-slip and normal focal mechanisms along the block-continental margin and normal faulting along the block-oceanic margin [Elliott et al. 2010]. This system may help constrain how the present hypothesis may be tested and a useful comparison for interpreting any collected data.

Hypothesis

Based on the occurrence of earthquakes in the area, we believe that a series of reverse faults exist off of the Patton Escarpment. This fault system may be linked to the Borderlands fault systems by a structure that trends NE/SW off of the Borderlands as does the focal mechanism of the 2012 quake. Furthermore, this may be evidence for a transpressional block structure extending from the escarpment out towards the Pacific Plate and transfers strain along a series of faults.

This project searched for sites of faulting and generated sub-bottom profiles for use in assessing the hypothesis. Mapping and structure determination was the first step in addressing this hypothesis with future work explicitly modeling the proposed mechanism.

EM302 Multibeam

The EM302 multibeam system is capable of deriving high resolution topographic maps of the seafloor from depths ranging from 200-4000 m making it well suited to this study region, which lies at 3000-3500 m water depth. This sonar system is capable of detecting surface incongruities and topographic relief which are a direct result of faulting in many cases.

TOPAS Sub-bottom Profiler (chirp)

The sub-bottom profiler was used to search for sites of recent faulting (decadal time scales) due to breaks in sediment layers and will be used in conjunction with the EM302 to develop a synoptic understanding of the geodynamic surface features in the vicinity of the reported epicenter of the 2012 earthquake.

Gravimeter

Gravity measurements were collected and will be used to determine if a large fault or fault system exists within the study region since such a feature could result in a local gravity anomaly.

Study Plan

The executed survey plan followed an east-west grid path flowing from the north to the south of the area of interest (Figure 3). By making the principle survey lines parallel to the reported normal focal mechanism, we maximized the chance of observing the results of seismic activity in the sub-bottom profiles. Additionally, it minimized the use of dedicated ship time by aligning this survey with both the previous and next survey locations. The survey was concluded by a south to north transect through the middle of the survey grid along the most promising features discover by the initial survey. This transect provided superior multi-beam data when compared to the initial, likely incomplete survey while minimizing the use of ship time.

Potential Impact

This study aims to identify possible fault and weakness zones within the oceanic lithosphere that have the potential to generate earthquakes of magnitudes that can affect coastal areas of California and Mexico, This study will also help constrain the seismically active margins of the Pacific Plate and develop a more comprehensive knowledge of the geologically dynamic Borderlands region. The data collected will provide benchmark work that can be used for future studies.

Hello kitty

The Southern California Borderlands is a tectonically active region comprised of several Cenozoic basins and ridges [Hawkins et al., 1971]. High heat flow has also been detected in the region [Lee and Henyey, 1975]. Our study is focused on a region just south of the Northeast Bank, in the northern portion of the Long Basin (Figure 3). Our study focused on two topographic highs, one surrounded by an apparent moat, one without. We conducted a multi-pronged investigation to characterize the geological and biological nature of these features.

To the East is the Patton Escarpment, a thrust fault that separates the Borderlands from the deep oceanic plain. To the west is the Ferrelo Fault Zone, a right-lateral strike slip fault that may be the border between subduction complex rocks to the east and Eocene to Miocene accretionary sedimentary rocks to the west [Ryan et al., 2012]. To the north is a wave-cut Pliocene age (4.5 Ma) basaltic volcano, the Northeast bank [Hawkins et al., 1971]. Samples recovered from the Northeast Bank included unaltered and altered basalts, volcanic breccia, and hyaloclastites. Macrofossils recovered include *Ostrea sp.* and *Patinopectin sp.* – species whose modern counterparts live in waters shallower than 50 m. The fossils are of Pliocene or early Pleistocene age [Hawkins et al., 1971].

A couple of areas with similar features include the serpentine volcanoes at the Mariana Subduction Zone and Izu-Bonin Arc.Analogue and/or the methane/volatile-mobilized mud volcanoes further north in the Santa Monica Basin [Davis et al., 2002; Fryer, 1992].

Working Hypotheses:

Topographic highs are related to subduction complex rocks and are geologically inactive, yet biologically active.

Topographic highs are related to methane/fluid mobilization of deeper sediments that erupt as "mud volcanoes."

The seamounts and the area around each mound are expected to contain high levels of trace elements (Mo, U, Cr, and V) and metals (Ag, Hg, Cd, Ti, Cr, As, and Sb), resulting from interaction with primary magmatic or metamorphic fluids. Hence, these features are younger than the underlying ocean crust and likely formed by volcanic eruptions induced by continued fault movement.

The seamount moats formed through scouring of sediments by strong ocean currents.

The seafloor mounds are formed as a result of rapid high heat flow in the subsurface and fluid flux reaching the seafloor.

Some mounds are associated with thrust faults, forcing colder, near seafloor sediments to greater depth forming moats on the surface.

Multibeam

New multibeam data from the EM 302 can be compared to multibeam data collected in 2002. A bathymetry surface comparison may reveal temporal changes in either or both topographic features. Backscatter imagery from the EM 302 data can also be used to compare the two features to each other – it would be difficult to compare the backscatter data sets between old and current survey without further ground truth samples such as sediment samples. Both data sets will be processed in Caris HIPS and SIPS and analyzed in Fledermaus.

Chirp/Sub-bottom Profiler

Subsurface data across axis of both topographic features will allow for depositional comparison between the two. It will also be able to discern if the absence of moat on the western feature is real or an artifact of the data.

ADCP

We will measure ocean currents throughout the water column with the ship's acoustic Doppler current profiler (ADCP). If the current was responsible for the removal of sediment, we would expect two possible observations. The first would be strong current velocities at depth and the second would be large grain size of sediments within the moat. The use of an ADCP would help with the first observation. However, complications could arise because of the models of 75 kHz and 150 kHz ADCP may have limited range. We would use the 75 kHz as it has a deeper range of approximately 500 meters, however this will not cover most of the water column in the survey area. Despite the not resolving the bottom part of the water column, the surface currents might give an indication of currents interacting with the seamounts. During and post cruise ADCP profiles will be analyzed to characterize the vertical and spatial distribution of currents along the survey.

DRAFT

Gravity

Shipboard BGM-3 marine gravity meter data was used to measure the gravity anomalies associated with the subsurface rocks. In conjunction with the multibeam data, the gravity data will be used to constrain the density structure of the seafloor mounds. The changes in subsurface rock density indicate the nature of the rocks and potential internal structure of the mounds, in particular if the mounds are of a sedimentary or volcanic origin.

Gravity Cores

Three total cores were extracted from the seafloor: One from the central peak of each topographic high, on from the sea floor adjacent to peaks (regardless of presence of moat or not), and one from the nearby abyssal plain for a control on the sediments. Analysis of returned sedimentary material to possibly constrain the overall composition of the features.

Isotopic Study

Apply stable isotopes to bulk sediments and microfossils (i.e. foraminifera, diatoms, radiolarian) in the sediment to understand when the mud volcanoes formed, whether they were related to methane release activity, and compare paleoenvironments between the two. 5 – 10 g samples will be taken of different lithological sections (if any) and put into the freezer on board for preservation.

Testing hypothesis: $\delta^{13}C$ and $\delta^{18}O$ measurements on bulk carbonate and microfossils (i.e., foraminifera, diatoms, radiolaria) in different lithological sections of the recovered cores. A lighter $\delta^{13}C$ and a heavier $\delta^{18}O$ will diagnose whether any of the deposited sediment was related or in the vicinity of methane hydrate seepage. For bulk sediment, no extra preparation is necessary whereas the microfossils will be sieved and rinsed with alternating deionized water prior to running on the Stable Isotope Mass Spectrometer, either at Rutgers University of Lamont-Doherty Earth Observatory. These analyses will be done after the completion of the cruise.

To determine the source of carbon utilized in the shell formation of the fauna associated with these mud mounds, systematic sampling of bivalves and other associated fauna and sediment will be performed on each of the five cores in the HK site. Samples of shells will be taken to the University of Cincinnati for analysis of δ13C and 14C content. Live specimens (if any) will be rinsed in deionized water, dried, and frozen for transport to the University of Cincinnati for analysis of the δ13C and δ15N of shells selected tissues.

Sedimentary Facies/Provenance Study:

Sediment characterization, fossil identification, descriptions, and measurements will be documented for each core. A stratigraphic column will be constructed using this information. Samples from each depth interval will be collected, frozen and preserved for compositional analysis at the lab at San Francisco State University. X-ray fluorescence (XRF) will be used for bulk chemical analysis. X-ray diffraction (XRD) will be used to identify and characterize crystalline materials and fine-grained minerals. Because XRF and XRD have varied detection limits specific to each element (low ppm), elements concentration will not be detected. Microwave plasma-atomic emission spectrometry (MP-AES) will be used to observe the metals that were not detected using XRF. Using this data, along with the identification of fossils and fossil fragments, we will be able to determine the potential sources and approximate ages of the seamounts. This will also constrain their origin and melting processes were involved in their formation. Microfossil samples, if present will also be collected and analyzed for correlation with macrofossil studies.

Stratigraphy and structure of the seafloor will be determined through detailed seafloor surveys using a chirp sub-bottom profiler aboard the R/V Sikuliaq, followed by measurements and analysis of each of the five extracted cores. To determine the mechanisms of mound formation, cores will be examined for evidence of methane-induced diagenesis in the form of methane-derived carbonate cements, as well as indicators of the injection and extrusion of material in the form of hydrocarbon-rich muds. Comparisons will be made between two cores located on the mound tops and two located on the base of each mound; a fifth will provide a control sample on the flat seafloor. The stratigraphic position of sediment and carbonate samples within each core will be recorded and samples will be taken to the University of Cincinnati for analysis. Sediment source and composition will be determined using a combined X-ray diffraction (XRD), X-ray fluorescence (XRF), and grain size analysis using facilities at the University of Cincinnati. Possible dating of the sediments may also be performed using radiocarbon measurements of the tests of any planktonic foraminifera specimens collected.

Iron Geochemistry

Pore water Fe(II) (on board, read samples back at Bigelow)

Solid phase Fe extractions (Bigelow)

Preserve pore waters in trace nitric acid upon return to lab. Any Fe isotope signature of pore water Fe that might indicate deep source release into overlying sediments?

Microbiology/Genomics:

Single-cell genomics samples preserved in glycerol and frozen at -80 °C. Ship back to Bigelow when in San Diego on dry ice.

Preserve samples for microbial community analysis (freeze at -80 °C) and also bring back some live samples for culturing in vacuum bags (a few grams of oxide rich material if present).

Goodbye kitty

Recent earthquakes in the Continental Borderland offshore of southern California suggest that the mapped faults in the region are very active [Astiz & Shearer, 2000; Hauksson et al., 2013]. The northwest-southeast trending faults are capable of hosting large earthquakes ($M \geq 7.0$) just offshore of major metropolitan areas. These large earthquakes are potentially tsunamigenic, and pose a direct risk to the coastal communities of southern California and northern Mexico [Legg et al., 2002]. Despite the seismic hazard these faults pose to the public, we do not yet have high resolution full-coverage maps of the borderland region. Prior multibeam surveys were conducted in the 80s and early 90s, and do not provide sufficient coverage to map the surface expression of the faults in detail. Sub-bottom data in the area is sparse.

Our project collected high-resolution multibeam bathymetry/backscatter (EM302 and EM710), CHIRP sub-bottom seismic data (TOPAS PS18; Figure 3), and a set of 3 gravity cores over a section of the San Clemente fault zone just south of San Clemente Island and west of Forty-mile Bank. Our goal was to determine the slip rate along this section of the fault by looking at the surface relief and sub-bottom structure, and constraining the amount of offset that has occurred. We will also use the sub-bottom and bathymetry data to look for evidence of methane cold seeps, which are associated with active faulting in offshore environments [Torres et al., 2002; Hein et al., 2006; Paull et al. 2008]. Where we saw evidence of methane seeps, we took gravity core samples to try to determine the source and extent of methane hydrates. Methane seeps and gas hydrates have been observed within the borderlands and the Santa Monica basin before [Torres et al., 2002], however, the extent and longevity of these features is not known.

The results of this study will help to constrain the tectonic evolution and current activity within the Continental Borderlands. We aim to further our understanding of the role tectonic activity plays in the migration of methane hydrates with the seafloor. As the distribution and activity of methane deposits are sensitive to ambient temperature and pressure, these deposits may also be useful as localized markers for a changing global climate.

Science Plan

We used sub bottom profiling, the EM302, and EM710 multi-beam bathymetry to identify active faults. The CHIRP sub bottom profiler will provide information on the sediment cover on those faults to determine whether they are active or not. High-resolution bathymetry will help us to distinguish methane seeps based on backscattering of return signals from the EM302, giving us a clearer image of tectonic activity and the distribution of methane seeps in the Borderlands.

Cores were taken on a return track after methane hydrate activity has been identified during the initial reconnaissance. In CHIRP data, release of methane often occurs on top of anticlines and can be seen as a bottom simulating reflector (BSR) and blanking. Gravity cores will be used to confirm the activity of methane seeps (i.e., stable isotopes, trace elements) and to potentially date how long have these areas been active (i.e., radiocarbon dating). Cores obtained in areas of methane seepage will likely be characterized by bubbles in the retrieved sediment with potential carbonate precipitates from the anoxic oxidation of methane. Stable isotopes will be used to identify whether the source of these methane seeps is identical to those retrieved previously from Santa Monica basin.

High-resolution sediment samples will be taken every ~2 cm for bulk stable isotopes ($\delta^{13}C$ and $\delta^{18}O$) from each gravity core to determine methane activity. If negative excursions in $\delta^{13}C$ are observed, detailed faunal studies (e.g., benthic and planktonic foraminiferal assemblages and abundances) will be conducted to define whether there is an associated biotic response to methane seepage, such as shifts in opportunistic taxa and dominant species. Additional stable isotopes will be conducted on individual benthic foraminifera if needed.

LMAO

"Out of sight out of mind", offshore faults and landslides are some of the most overlooked hazards to coastal cities. However, events like the 2016 Kaikoura, New Zealand, Mw 7.8 earthquake highlight the importance of this region. Early data suggest this event started as an on shore strike-slip rupture and evolved to include offshore thrust generating a small local tsunami. Recognition of the possibility multiple faults to rupture during a single event with different mechanisms highlights the need to better understand fault connectivity along the United States most comparable zone, the California Borderlands.

The estimated geodetic rate from block modeling of onshore continuous GPS suggests that Borderland faults accommodate up 20 percent of Pacific- North America Motion. The San Diego Trough Fault accommodates 1.5 mm/yr, implying the rest of the shear zone associated with the Borderlands may accommodate up to 9-10 mm/yr [Legg 1991,Larson 1993, Bennett et al., 1996]. Critical to understanding the hazard associated with this slip rate is the nature of submarine restraining bends within the fault system. These restraining bends are the location of thrust faults that connect offset strands of the right-lateral strike slip faults that extend the length of the borderlands. These thrust faults are potential locus of tsunamis for coastal California cities. Further, associated crustal thickening creates steep topography which, along with pre-existing basin range physiography, lead to over steepened slopes another potential tsunami source.

We explored the relationship between these restraining bends and submarine landslides. Specifically, we evaluated the hypothesis that landslide detachment faults can be reactivated as thrust faults during ongoing crustal shortening. This was done at Forty-mile bank, which is the location of both a restraining bend and a large landslide complex [~40 km^3].

Study Site

Along the San Clemente Fault (SCF), just to the south of San Clemente Island lies Forty-mile bank (FMB) which is a large landslide complex (Figure 3). The origin and exact timing of the landslide are still unclear. Possibly formation histories include: 1. Holocene coseismic slump; 2. Older feature of the sea-floor from the transtensional period that formed the basin and ridge topography of the region during the Miocene [Legg et al., 2007]. Seismic survey USGS-924 crosses through the bank highlighting a few interesting features. The first is the detachment fault that facilitates the greatest displacement during the landslide that extends from the fault scarp beneath the slumped mass. Within the slumped area a series of smaller faults cross the main block. Upturned beds, approaching orthogonal to the fault trace, are reported within the slumped block, while the shallow portion of FMB exhibits horizontal layering [Legg and Kamerling, 2007].

It is currently unclear in existing datasets how deep the detachment associated with landslides extends. However, immediately down dip from the landslide is the seafloor trace of the SCF which may accommodate up to 5-7 mm/yr of Pa-NA plate motion [Legg,1985] (Current SCEC estimate is 1.5 mm, www.service.caltech.scec.edu) making it one of the most important faults of the borderland system. The fault side steps the forty-mile bank as it moves northward from Baja, and eastern strands of it appear to offset the toe of the landslide to the Northwest. We look to determine if the detachment faults formed during the slumping event connect to the SCF, and have been reactivated as thrusts which accommodate crustal shortening as a result of bend in the San Clemente fault.

Earthquake evidence for reactivation

Historical earthquake locations (1951-2016) from the Southern California Earthquake Center (SCEC) show that the SCF is the 3rd most active fault strand of the Borderland system (Figure 1), behind high seismicity rates of the San Diego Tough Fault (SDTF) likely due to the prolonged aftershock sequence of the 1986 (Ms=5.8) Oceanside earthquake sequence and the portion of the Palos Verde fault system offshore San Diego. Near FMB, earthquake locations are diffuse through out the crust and not located along the trace of the SCF [Astiz and Shearer 2000]. These faults align with a Southwest dipping fault [Astiz and Shearer 2000] and are broadly consistent with the dip of the FMB although location uncertainty precludes direct association. Larger events for which moment tension inversions are possible show a large range of solutions with strike-slip being predominant and some thrust solutions (SCEC Moment Tensor Catalog, www.service.caltech.scec.edu). However, these events generally have a quality factor of ‘C’, implying low confidence.

Data acquisition plan:

The initial plan for the survey of the FMB is to run 6 slide perpendicular lines along with 4 slide parallel lines. The horizontal lines allow for good swatch coverage for bathymetric mapping of the slide surface and portions of the SCF, while horizontal lines are chosen to optimize data collection using the Sub-bottom profiler system (Topaz). Timing of these tracks is dependent on Military training activity within the area that excludes access to the toe of the landslide during certain hours (Figure S1). Survey planning is timed strategically to accommodate the time. This includes using time to fill gaps in existing multibeam tracks on the eastern side of the landslide.

Multibeams EM 302 and EM 710 will be used to identify slide features including scarps ,recent turbidite activity through comparison with existing Sea-beam data and provide geometry for later numerical models. Both systems will be ran in unison to provide optimal coverage for the rapidly changing water depths during the survey. This will also provide information for coring site selection at the end of the survey. The multibeam signal will also be used to identify methane seepage from the Fault zone and San Clemente fault using information from water column returns.

Sub-bottom Profiler (Topaz) will be collected with a focus on fault scarp perpendicular lines. This data will be used for correlation with identified surface scarps and estimation of dip angles of en-echelon detachments that make up the landslide complex. Washed out behavior also helps to identify regions of rigorous fluid flow and/or methane seepage.

Gravity anomaly data (BGM-3) will be acquired. It will be used to model the landslide detachment contact and determine how deep the detachment goes/ if it connects to the greater SCF system. The detachment surface separating the landslide from the main section of FMB is postulated to be the contact between Catalina Schist and terrigenous clastic sediments. We anticipate that the density contact between these two surfaces will provide a gravity signal indicating how deep the contact extents.

Gravity Corer will be used in conjunction with project "Bubble Kitty" in order to sample methane seep sites found through surveying, date the offset of the landslide toe in order to improve slip rate estimates, and sample turbidite sequences identified through the Sub-Bottom profiler. Two cores are planned as part of this project, with a supplementary 3 cores as part of project "Bubble Kitty" within the same study area. These will take place along the southwest horizontal transect near the SCF and landslide toe.

Proposed Research Tasks

Develop new 3d model of the FMB

Update seismic catalog with current data, including relocating seismicity in the FMB area using ALBACORE ocean bottom seismic network data

Identify and map all fault traces with the landslide complex

Develop 3d numerical model using gTecton FEM code to model landslide-fault interaction

Expected Results

We expect to show that the FMB is a currently active landslide complex which no responding to compressional stresses due to the movement. We will model the effects of these stresses on the landslide basement using elastic models accounting for a range of SCF slip rates. We will use this model to infer the seismic hazards associated with thrusts along the FMB and model the tsunami hazard for California coastlines based on these slip estimates.

Underway data sets

During the cruise we attempted to indoctrinate the students to a point of view about data acquisition. There were two priorities; 1) We are always collecting data. 2) The ship should not wait for science. As a result, all the underway instrumentation operated continuously from Honolulu to San Diego. The total along track profile is shown in Figure 4.

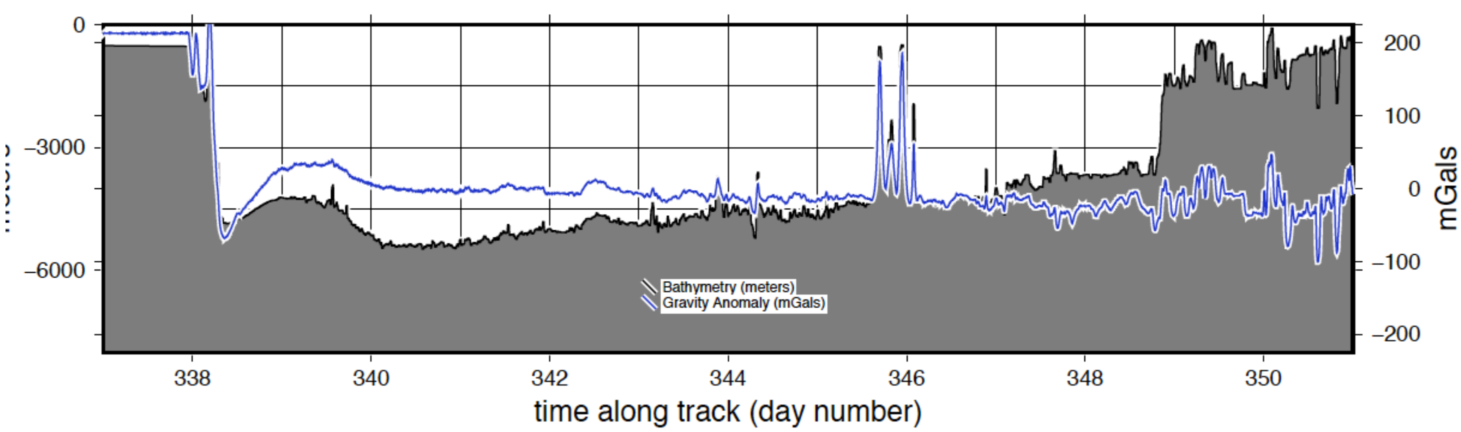


Figure 4 – Along track profile of reduced gravity anomaly data and center beam bathymetry for the entire cruise.

The cruise was well-supported by the onboard science officers, Bern McKernan and Steve Hartz. As a result, there were no substantial mechanical or computer failures during the entire time underway. Continuous operation of the instruments contributed to the success of the cruise by eliminating the unnecessary distraction of hardware or software failure.

Seafloor mapping (multibeam & Chirp)

Many of the underway projects relied on seafloor mapping data. So the continuous operation of the EM 302 multi-beam was crucial to these objectives. While the swath width was quite restricted in deep water (see Appendix D), a critical constraint for planning surveys, the data quality was quite good.

Periodic XBT and two CTDs were also collected during the cruise, providing SVPs for proper data reduction (Appendix E)

Gravity anomaly data

An opening gravity tie was done dockside in Honolulu and on the pier in San Diego (Appendix F). These ties constrained gravimeter drift over the period of the cruise. Partly due to the very favorable weather conditions, which minimized heave, the reduced gravity anomalies are very smooth and show the expected correlation with bathymetry (Appendix G).

Coring results

A number of cores were taken during the cruise. These are detailed in the narrative above and in Appendix H.

Wrapping up

During the week prior to arrival in San Diego, assignments for the cruise report were handed out. These writing assignments, augmented by additional text and figures were compiled on the final day and edited later into a single cruise report shared among the participants. Requirements for post-cruise data submission to appropriate archives (e.g. NGDC, R2R) were also discussed, building on the earlier use of archival data for cruise planning.

Participant Surveys

To document the success of the cruise, which sought to develop skills and confidence for submitting sea-going NSF proposals. Participants took pre (results tabulated in Appendix I) and post cruise surveys (Appendix J). The results of these surveys are tabulated in Appendix K.

Post-cruise

Post-cruise, two of the participants have taken the initiative to prepare publications based on the cruise itself. The first is an article that will appear in EOS, discussing both the cruise objectives and the results of the hunt for seeps in the California Borderlands. The second is an abstract for the Fall AGU that will delve into the investigation of some unexpected earthquakes that appear to have taken place on oceanic crust, off the Borderland.

References

Astiz, L., and P.M. Shearer, P.M., 2000, Earthquake Locations in the Inner Continental Borderland, Offshore Southern California, **Bulletin of the Seismological Society of America** 90, 425-449.

Bennet, R. A., W. Rodi, and R.E. Reilenger, 1996, Global Positioning System constraints on fault slip rates in southern California and northern Baja, Mexico. **Journal of Geophysical Research** 101, 943-960.

Blair C.C. et al., 2007, Radiolytic Hydrogen and Microbial Respiration in Subsurface Sediments, **Astrobiology** 7, 951-970.

Bowden D.C., M.D. Kohler, V.C. Tsai and D.S. Weeraratne, 2016, Offshore Southern California lithosphere velocity structure from noise cross-correlation functions, **Journal of Geophysical Research** 121 3415-3427.

Davis, A. S., D.A. Clague, W.A. Bohrson, G.B. Dalrymple and H.G. Greene, 2002, Seamounts at the continental margin of California: A different kind of intraplate volcanism, **Geological Society of America Bulletin** 114, 316-333.

Elliott J.L., C.F. Larsen and J.T. Freymueller, 2010, Tectonic block motion and glacial isostatic adjustment in southeast Alaska and adjacent Canada constrained by GPS measurements. **Journal of Geophysical Research** 115

Fryer, P., 1992, A Synthesis of Leg 125 Drilling of Serpentine Seamounts on the Mariana and Izu-Bonin Forearcs.

GEBCO, 2014, The GEBCO 2014 Grid, www.gebco.net

Gee, J., L., J.A. Tauxe, H. Hildebrand, H. Staudigel, and P. Lonsdale, 1988, Nonuniform magnetization of Jasper Seamount, **Journal of Geophysical Research** 93, 12,159–12,175, doi:10.1029/ JB093iB10p12159.

Gee, J., H. Staudigel and J. H. Natland, 1991, Geology and Petrology of Jasper Seamount, **Journal of Geophysical Research** 96, 4083– 4105, doi:10.1029/90JB02364.

Hammer, P.T.C., J.A. Hildebrand, and R.L. Parker, 1991, Gravity inversion using seminorm minimization: Density modeling of Jasper Seamount, **Geophysics**, 56, 68–79, doi:10.1190/1.1442959.

Hammer, P.T.C., L.M. Dorman, J.A. Hildebrand, and B.D. Cornuelle,1994, Jasper Seamount structure: Seafloor seismic refraction tomography, **Journal of Geophysical Research** 99, 6731–6752, doi:10.1029/93JB02170.

Hauksson, E., H. Kanamori, J. Stock, M. Cormier and M. Legg, 2013, Active Pacific North America Plate boundary tectonics as evidenced by seismicity in the oceanic lithosphere offshore Baja California, Mexico, **Geophysical Journal International** 196, 1619-1630

Hawkins, J. W., E.C. Allison and D. MacDougall, 1971, Volcanic Petrology and Geologic History of Northeast Bank, Southern California Borderland, **Geological Society of America Bulletin** 82, 219-228.

Hein, J.R., W.R. Normark, B.R. McIntyre, T.D. Lorenson, and C.L. Powell II, 2006, Methanogenic Calcite, 13C-Depleted Bivalve Shells, and Gas Hydrate from a Mud Volcano Offshore Southern California, **Geology** 34, 109-112

Hildebrand, J.A., L.M. Dorman, P.T.C. Hammer, A.E. Schreiner, and B.D. Cornuelle, 1989, Seismic tomography of Jasper Seamount, **Geophysical Research Letters** 16, 1355 – 1358, doi:10.1029/GL016i012p01355.

Homoky W.B., 2013, Distinct iron isotopic signatures and supply from marine sediment dissolution, **Nature Communications** 4, 2143.

Kallmeyer, J, et al., 2012, Global distribution of microbial abundance and biomass in subseafloor sediment, **Proceeding of the National Academy of Sciences** 109, 16213-16216.

Konter, J.G., H. Staudigel, J. Blichert-Toft, B.B. Hanan, M. Polve, G.R. Davies, N. Shimizu, and P. Schiffman, 2009, Geochemical stages at Jasper Seamount and the origin of intraplate volcanoes, **Geochemistry, Geophysics, Geosystems** 10, Q02001, doi:10.1029/2008GC002236.

Koons P.O., B.P. Hooks, T. Pavlis, P. Upton and A.D. Barker, 2010, Three-dimensional mechanics of Yakutat convergence in the southern Alaskan plate corner, **Tectonics** 29

Larson, K. M., 1993. Application of the Global Positioning System to crustal deformation measurements, 3, Result from the southern California borderlands. **Journal of Geophysical Research** 98, 713- 726

Lee, T.-C., and T.L. Henyey, 1975, Heat flow through the Southern California Borderland, **Journal of Geophysical Research** 80, 3733-3743.

Legg, M. R., C. Goldfinger, M.J. Kamerling and J.D. Chaytor, 2007, Morphology , structure and evolution of California Continental Borderland restraining bends. **Journal of the Geological Society of London**, 143–168

Legg, M. R., 1985. Geologic structure and tectonics of the inner continental borderland offshore northern Baja California, Mexico. PhD thesis, University of California,

Legg, M. R., 1991, Developments in understanding the tectonic evolution of the California Continental Borderland, in From Shoreline to Abyss, vol. 46, edited by R. H. Osborne, pp. 291–312, SEPM Shepard Commemorative., Tulsa, Okla.

Legg, M., Borrero, J.C., and Synolakis, C.E. (2002) Evaluation of the Tsunami Risk to Southern California Coastal Cities, NEHRP Professional Fellowship Report.

Legg, M. R. and M.J. Kamerling, 2007, Large-scale basement involved Landslides, California Continental Borderland, **Pure and Applied Geophysics**

Meyer, B., R. Saltus and A. Chulliat, 2016, EMAG2: Earth Magnetic Anomaly Grid (2-arc-minute resolution) Version 2. National Centers for Environmental Information, NOAA. Model. doi:10.7289/V5H70CVX

Müller, R. D., M. Sdrolias, C. Gaina, and W. R. Roest, 2008, Age, spreading rates, and spreading asymmetry of the world's ocean crust, **Geochem. Geophys. Geosyst**. 9, Q04006, doi:10.1029/2007GC001743.

Paull, C.K., W.R. Normark, W. Ussler III, D.W. Caress and R. Keaton, 2008, Association Among Active Seafloor Deformation, Mound Formation, and Gas Hydrate Growth and Accumulation within the Seafloor of the Santa Monica Basin, Offshore California

Poulton S.W. And D.E. Canfield, 2005, Development of a sequential procedure for iron: implications for iron portioning in continentally derived particulates, **Chemical Geology** 214, 209-221

Pringle, M.S., H. Staudigel, and J. Gee, 1991, Jasper Seamount: Seven million years of volcanism, **Geology** 19, 364 – 368, doi:10.1130/0091-7613(1991)019<0364:JSSMYO>2.3. CO;2.

Røy H et al. (2012) Aerobic Microbial Respiration in 86-Million-Year-Old Deep-Sea Red Clay, **Science** 336, 992-995.

Ryan, H. F., J.E. Conrad, C.K. Paull and M. McGann, 2012, Slip Rate on the San Diego Trough Fault Zone, Inner California Borderland, and the 1986 Oceanside Earthquake Swarm Revisited, **Bulletin of the Seismological Society of America** 102, 2300-2312.

Sandwell, D. T., E. Garcia, K. Soofi, P. Wessel, and W. H. F. Smith, 2013, Towards 1 mGal Global Marine Gravity from CryoSat-2, Envisat, and Jason-1, **The Leading Edge** 32, 892-899, doi: 10.1190/tle32080892.1.

Staudigel, H. and D.A. Clague, 2010, The Geological History of Deep-Sea Volcanoes: Biosphere, Hydrosphere, and Lithosphere Interactions, Oceanography, Seamounts Special Issue, **Oceanography** 32 (1).

Stookey L.L.,1970, Ferrozine—A new Spectrophotometric Reagent for Iron, **Analytical Chemistry** 42, 779-781.

Torres, M.E., J. McManus, and C. Huh, 2002, Fluid Seepage along the San Clemente Fault Scarp: Basin-Wide Impact on Barium Cycling, **Earth and Planetary Science Letters** 200, 181-194

Walsh EA et al., 2016, Bacterial diversity and community composition from the seasurface to subseafloor. ***ISMEJ*** 10, 979-989.

Appendix A - Participants and Group Photo

UNOLS Cruise Personnel Manifest

Send completed form to: dropbox@rvdata.us
Subject Line: [CALLSIGN] Personnel Manifest

Ship* RV Sikuliaq
Cruise ID*
Cruise Title* MGG Training

Start Date:* 2-Dec-16 **End Date:*** 17-Dec-16
Start Port:* Honolulu **End Port:*** San Diego

Cruise Party Information

Last Name*	First Name*	Institution*	Role*	Gender*
Beam	*Jacob*	Bigelow Laboratory for Ocean Sciences	Scientist, Post-Doc	M
Blackburn	*Amanda*	University of Alaska Fairbanks	Student, Graduate	F
Brizzolara	*Jennifer*	University of South Florida College of Marine Science	Student, Graduate	F
Brown	*Kristin*	University of Alaska Fairbanks School of Fisheries & C	Student, Graduate	F
Coakley	*Bernard*	University of Alaska, Geophysical	Scientist, Chief	M
Dzaugis	*Mary*	University of Rhode Island	Scientist	F
Frisch	*Lauren*	University of Alaska Fairbanks School of Fisheries and	Scientist	F
Fung	*Megan*	Rensselaer Polytechnic Institute	Student, Graduate	F
Guerra	*Melania*	University of Washington	Scientist, Post-Doc	F
Hodson	*Timothy*	Northern Illinois University	Student, Graduate	M
Kelly	*Thomas*	Florida State University	Student, Graduate	M
Lankiewicz	*Thomas*	University of California Santa Barbara	Student, Graduate	M
Niehaus	*Joseph*	Texas A&M University	Scientist, Post-Doc	M
Pockalny	*Robert*	University of Rhode Island	Scientist, Co-Chief	M
Roberts	*Megan*	University of Alaska Fairbanks	Student, Graduate	F
Schwalbach	*Cameron*	University of Cincinnati	Student, Graduate	M
Schwehr	*Monica*	Monterey Bay Aquarium Research Institute	Scientist, Post-Doc	F
Urann	*Benjamin*	Woods Hole Oceanographic Institution	Student, Graduate	M
Voss	*Nicholas*	University of South Florida	Student, Graduate	M
Watson	*Lauren*	NA	Student, Graduate	F
Wertman	*Christina*	GSO University of Rhode Island	Student, Graduate	F
Yanchilina	*Anastasia G.*	Weizmann Institute of Science	Scientist, Post-Doc	F
Yelisetti	*Subbarao*	Texas A&M University-Kingsville	Scientist	M
Zayac	*John*	The Graduate Center, CUNY	Student, Graduate	M


Nick Voss
Kristin Brown
Lauren Frisch
Cameron Schwalbach
Mary Dzaugis
Anastasia Yanchilina
Jennifer Brizzolara
Christina Wertman
Melania Guerra
Megan Roberts
Megan Fung
Niki Watson
Subbarao Yelisetti
Tim Hodson
Tom Lankiewicz
Monica Schwer
Rob Pockalny
Amanda Blackburn
Tom Kelly
Joe Niehaus
Bernie Coakley
Jake Beam
John Zayac
Ben Urann

Appendix B - Honolulu Schedule

Day 1 (Nov. 29th) UH Manoa Campus; HIG Building; Room 601

08:15 1st Shuttle to HIG

09:00 Welcome aboard and plan for the time in Honolulu. (R & B)

09:15 Pre-cruise evaluation form (R & B)

09:30 Life at sea.(R & B)

10:30 Coffee break
10:45 Identify a problem? (R & B)
11:15 Identify funding
Part 1 NSF (B & R)
Part 2 Other sources (Margo Edwards HIG)
12:30 Lunch
13:30 Finding Data (Geomapapp and NGDC) (R)
14:15 Experiment with Geomapapp

15:15 Coffee break
15:45 Continue with Geomapapp

17:00 Discussion on science to be done during cruise (R & B)

17:30 Summary and wrap up (R & B)

18:00 Depart for Group Dinner at Tokoname

Evening Student prepare maps or other documentation for their purposes.

Presenters are Rob Pockalny (R) and Bernie Coakley (B)

Day 2 (Nov. 30th) UH Manoa Campus; HIG Building; Room 601

08:15 1st Shuttle to HIG

09:00 Overview of planned ship track (B)

09:15 Presentation on the science opportunities underway (R)

10:30 Coffee break

10:45 Discussions and organizing advocate groups for projects

12:30 Lunch

13:30 Discussions within groups - finding data

14:30 Brief presentations from groups about science objectives along track

15:30 Group discussion on science opportunities and time and data constraints

18:00 Shuttle to hotel - Dinner on your own

Presenters are Rob Pockalny (R) and Bernie Coakley (B)

Day 3 (Dec 1) Moving onto RV Sikuliaq

11:00 1st Shuttle from the New Otani to RV Sikuliaq

12:00 Last Shuttle from the New Otani.

12:15 Lunch

13:30 Safety briefing

14:30 Ship tours

15:30 Shuttle trip to stores

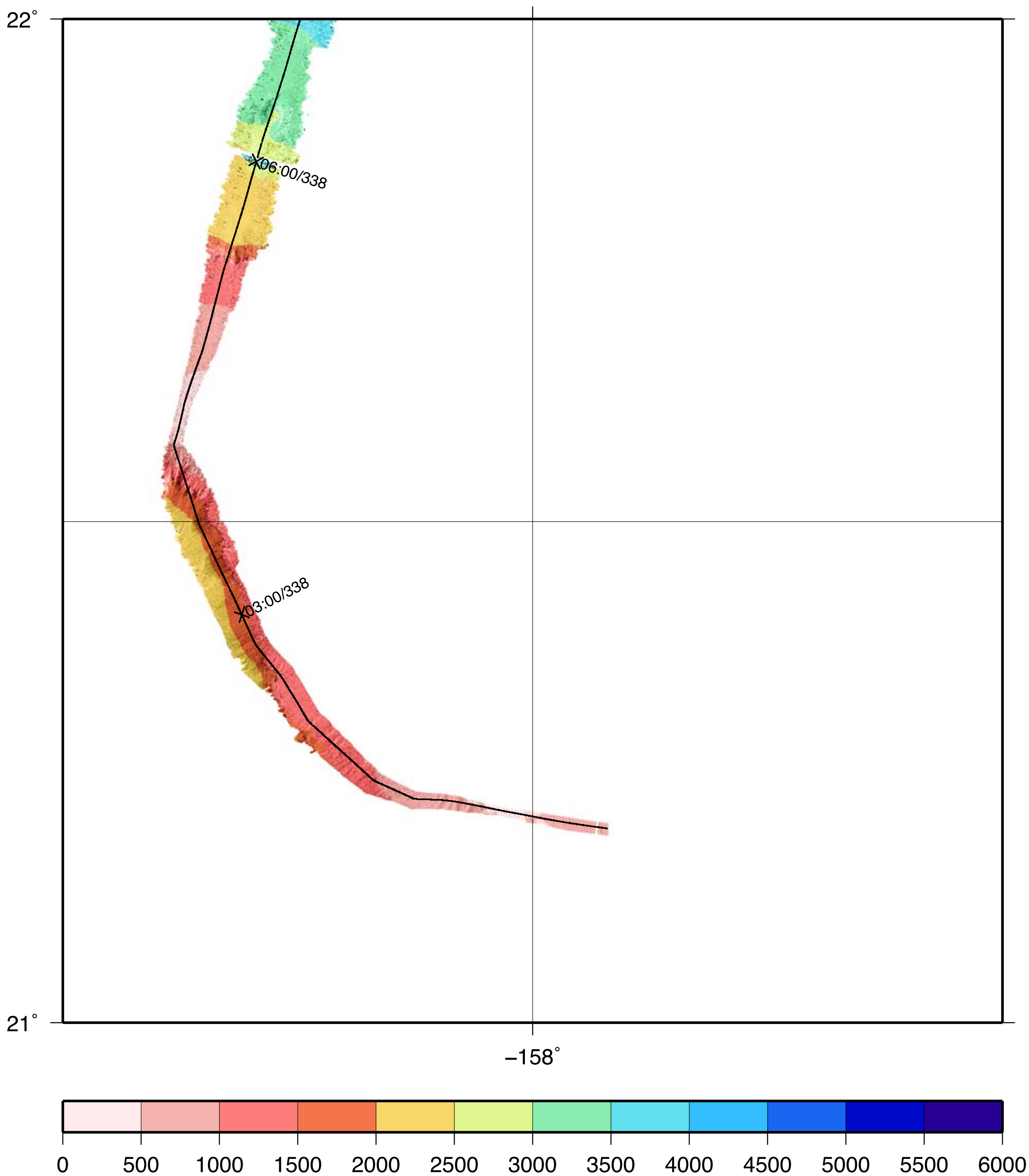
18:00 Depart for Group Dinner at La Marina

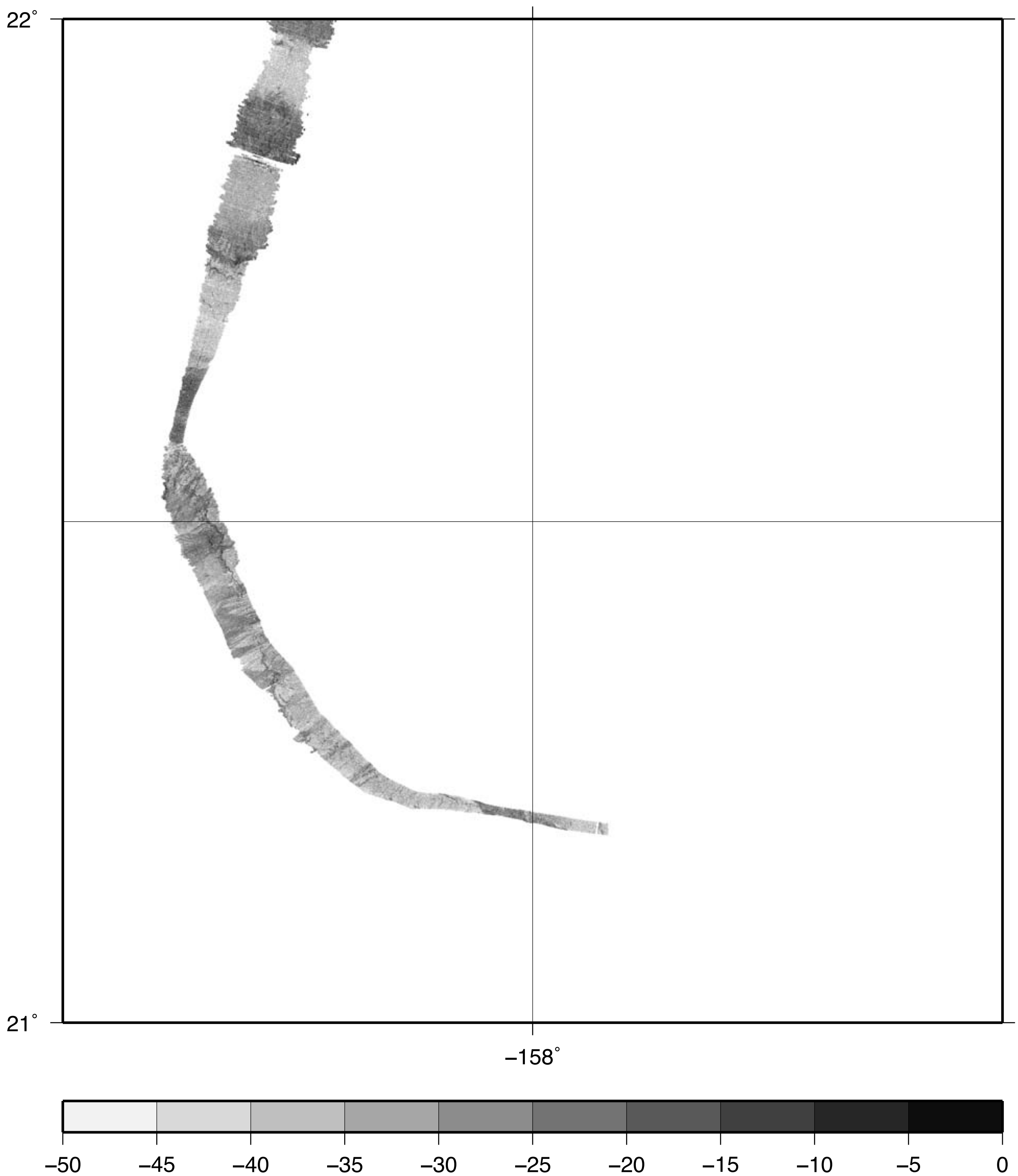
Appendix C - Talks on board RV Sikuliaq

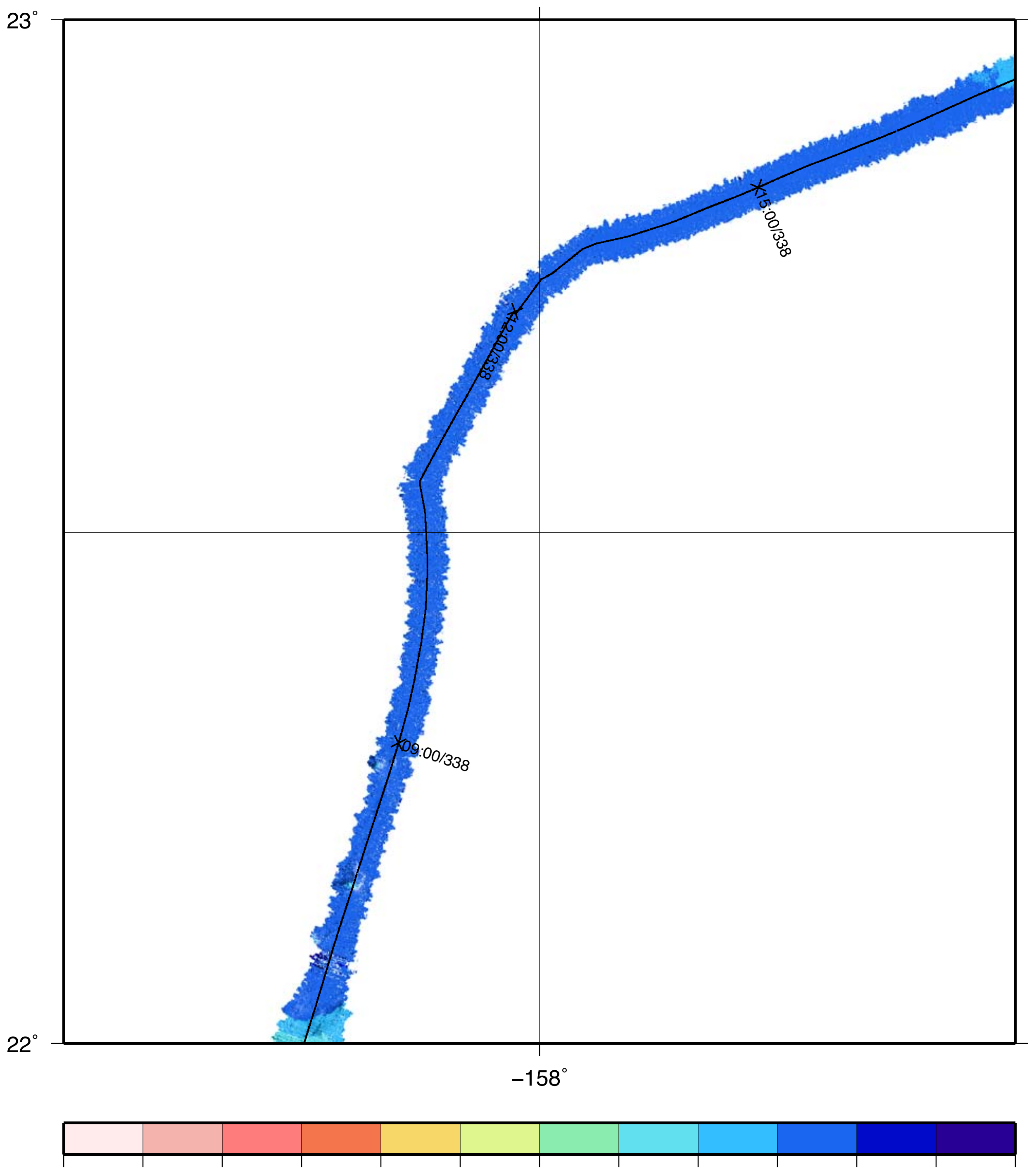
02 December	Ship	Welcome on board/Safety Briefing/Drills
03 December	All	Cruise track Proposals
04 December	Bern McKiernan	Instrumentation on board
05 December	All	Cruise track plans/discussion
06 December	Monica Schwer	Multi-beam
07 December	All	Presentation of the total track
08 December	Nick/Bernie	FInal Track/The NSF ecosystem
09 December	Rob	What is an NSF Proposal?
10 December	Bernie	Gravimetry for fun and profit
11 December	Bernie	Grant Reporting
12 December	Rob	What is UNOLS?
13 December	Christina	ADCP for beginners
14 December	Bern	Science from ship perspective
15 December	Bernie	What are reviews for?
16 December	Bernie	Post-cruise evaluation
17 December	Rob/Bernie	Checking out of your rooms.

Appendix D - EM 302 Plots (1˚ x 1˚)

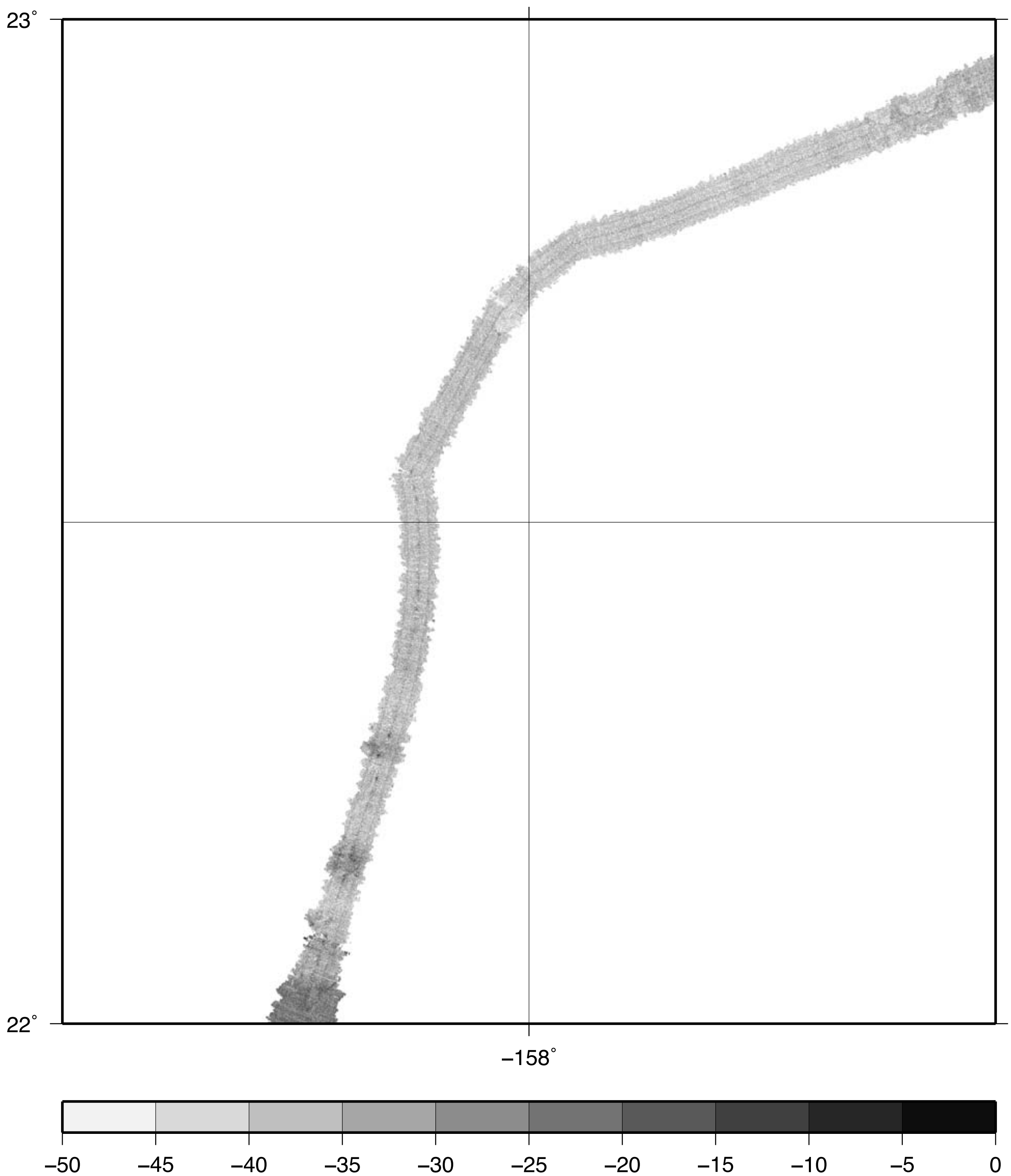
backscatter and bathymetry


22˚
21˚
−158˚
06:00/338
03:00/338
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000

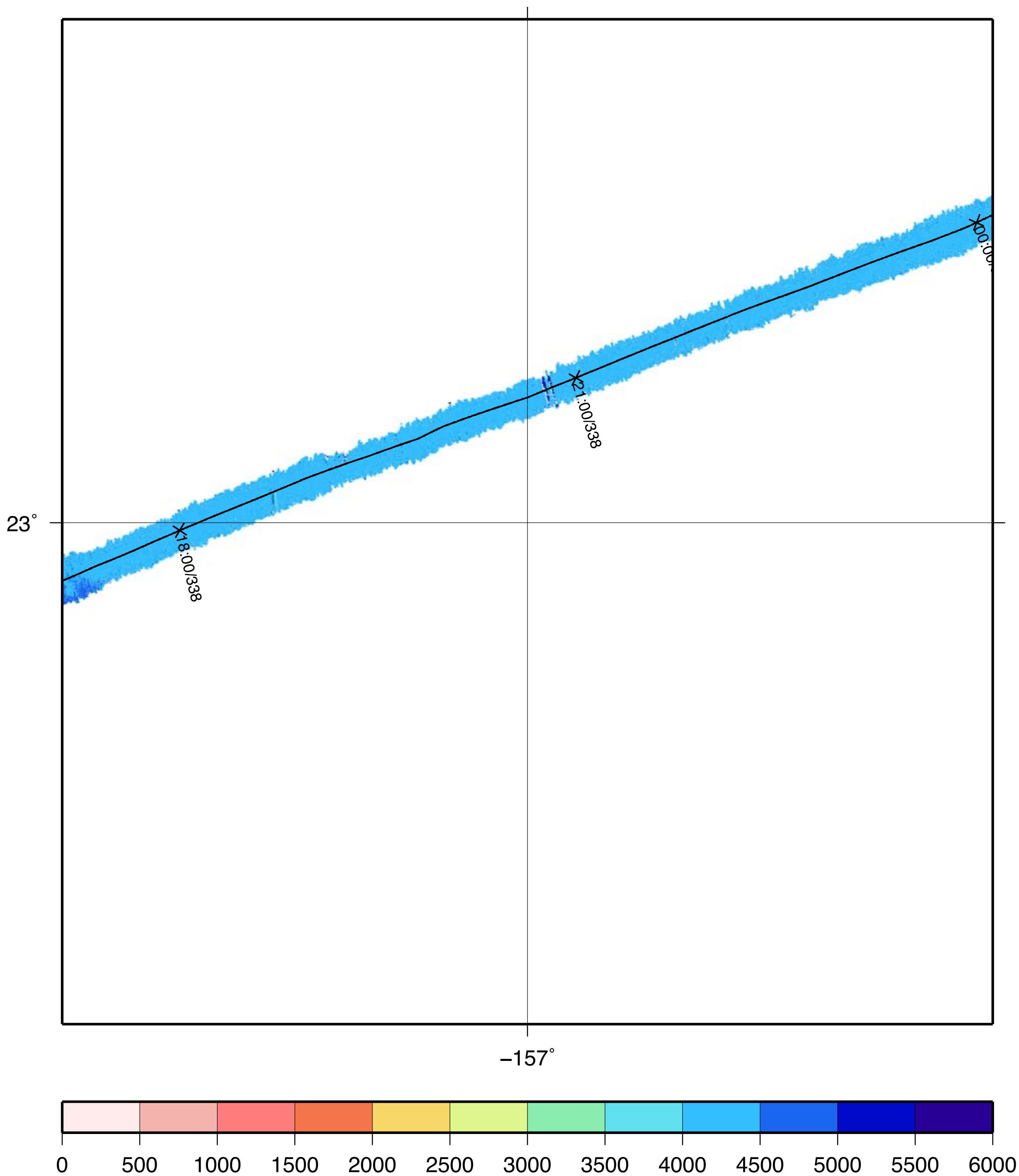

22°
21°
−158°
−50
−45
−40
−35
−30
−25
−20
−15
−10
−5
0



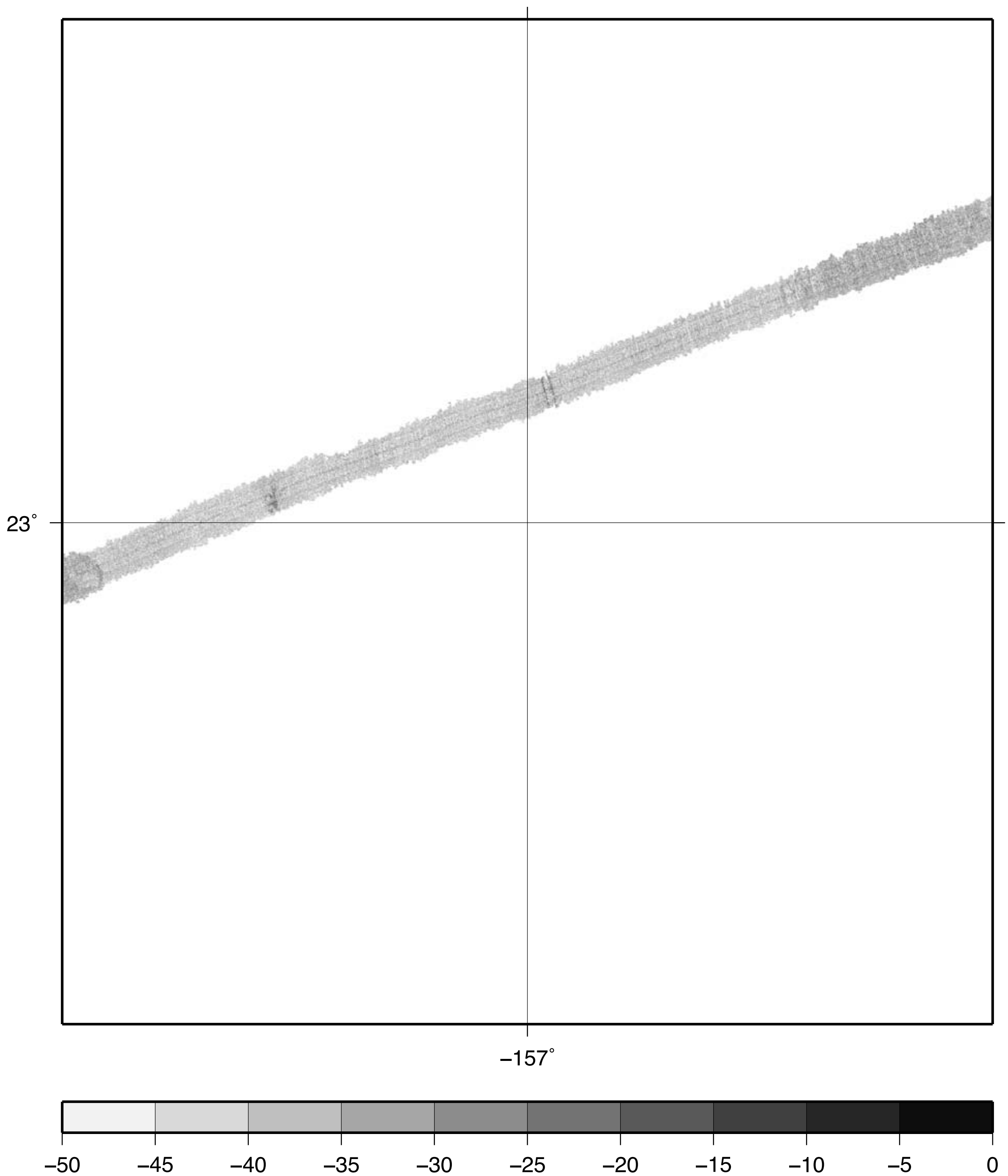
23˚
22˚
−158˚
15:00/338
12:00/338
09:00/338
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000

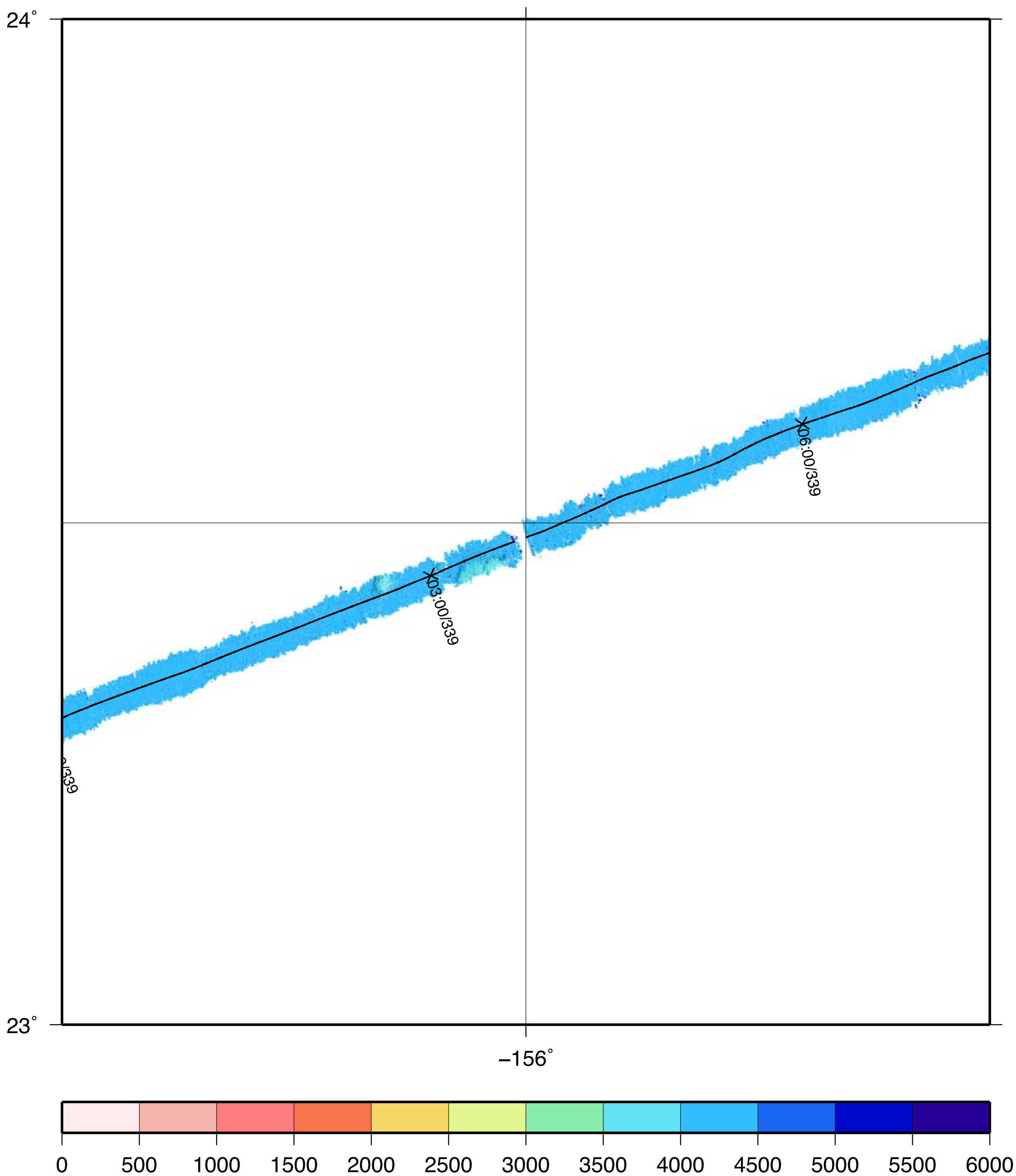


23˚
22˚
−158˚
−50
−45
−40
−35
−30
−25
−20
−15
−10
−5
0

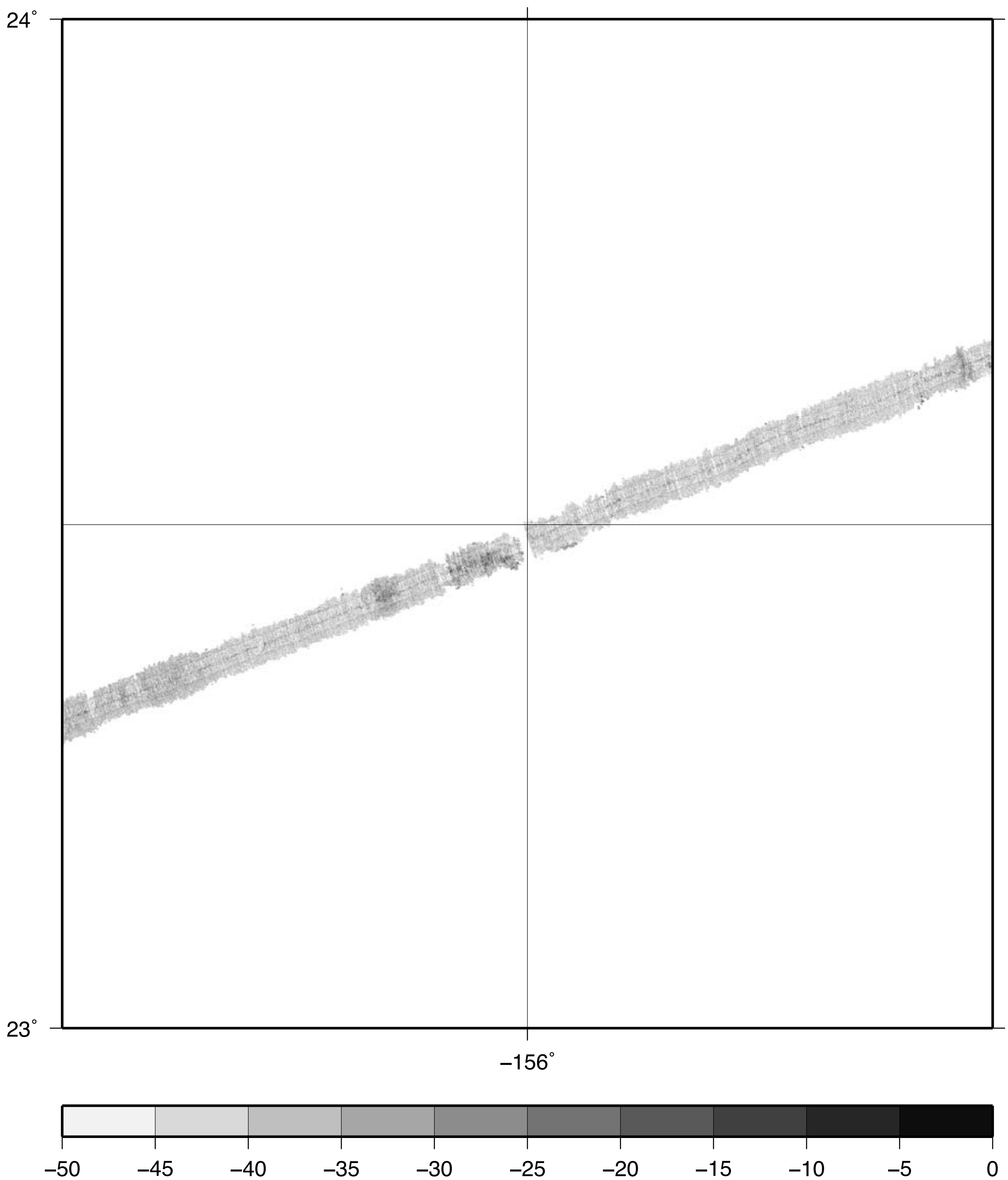


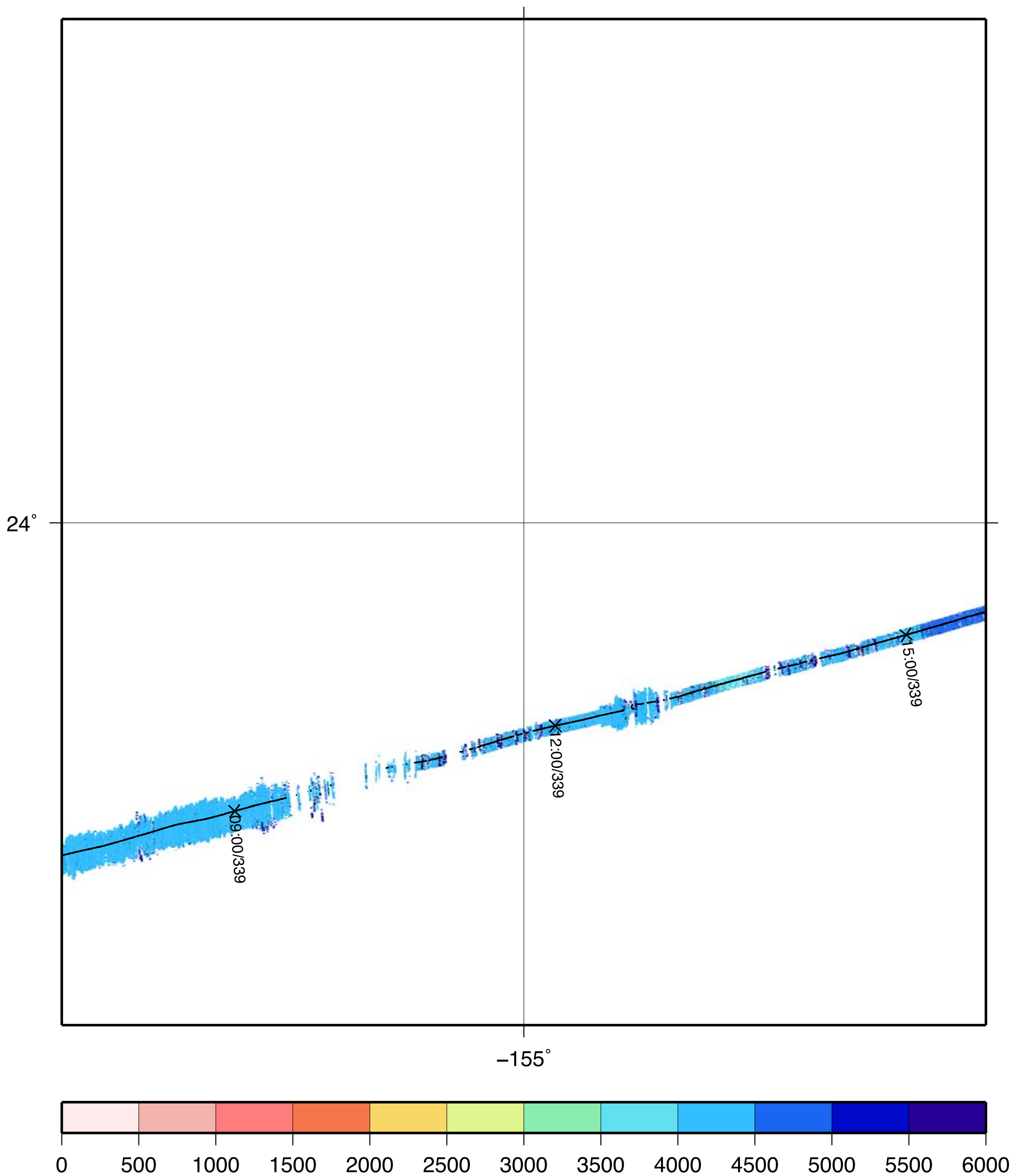
23˚
18:00/338
21:00/338
00:00
−157˚
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000


23°
−157°
−50
−45
−40
−35
−30
−25
−20
−15
−10
−5
0

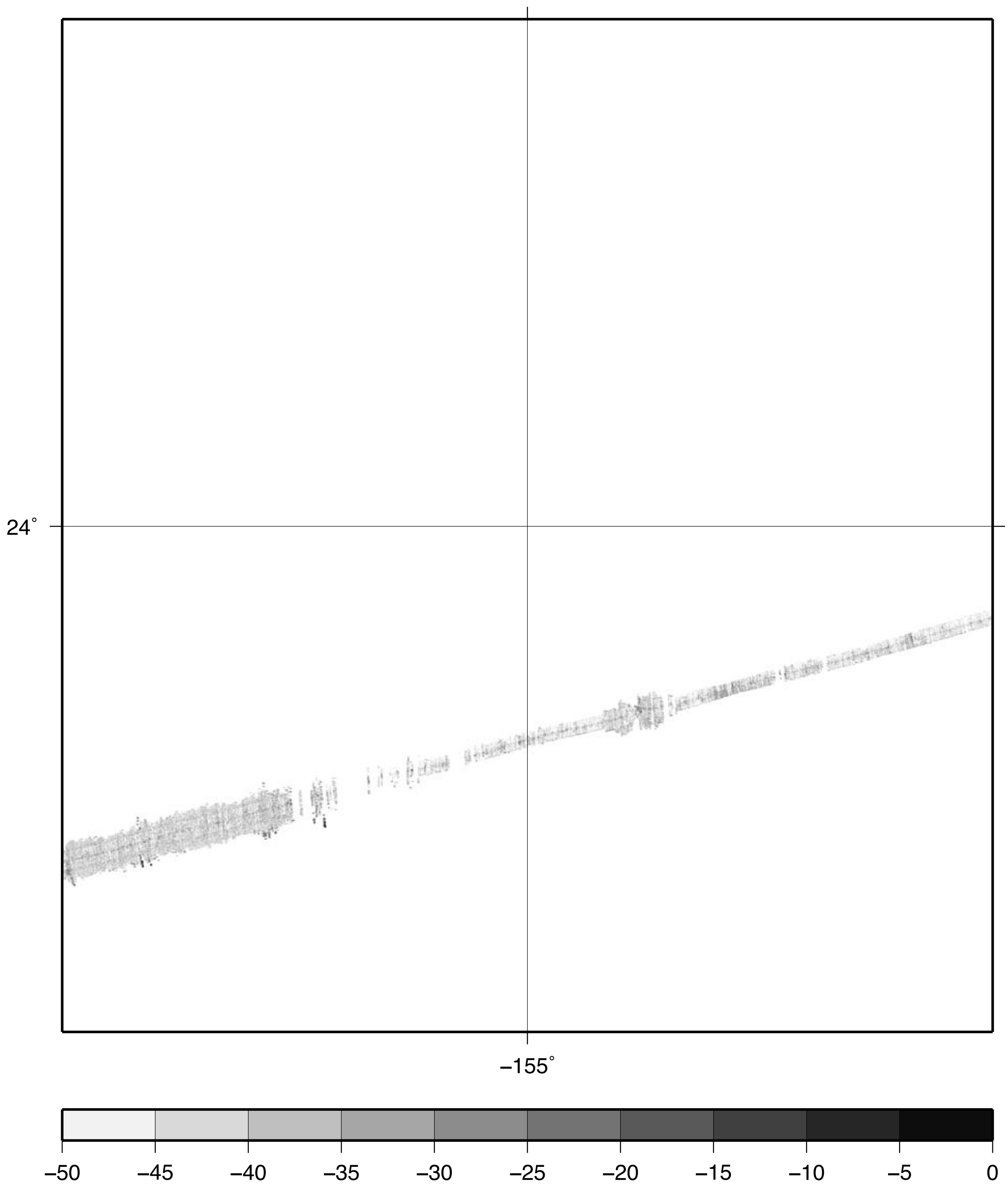


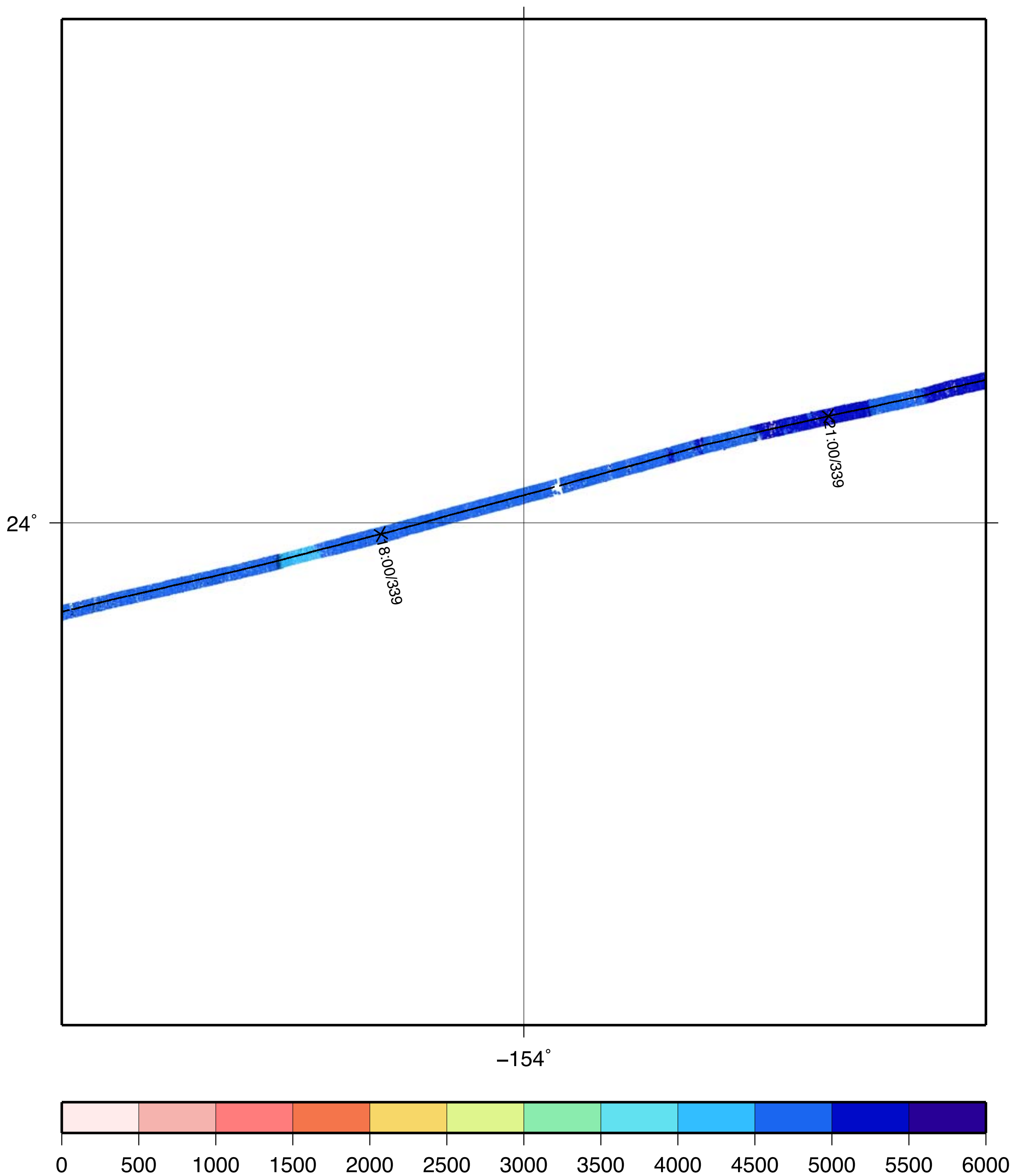
24˚
23˚
−156˚
03:00/339
06:00/339
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000


24°
23°
−156°
−50
−45
−40
−35
−30
−25
−20
−15
−10
−5
0

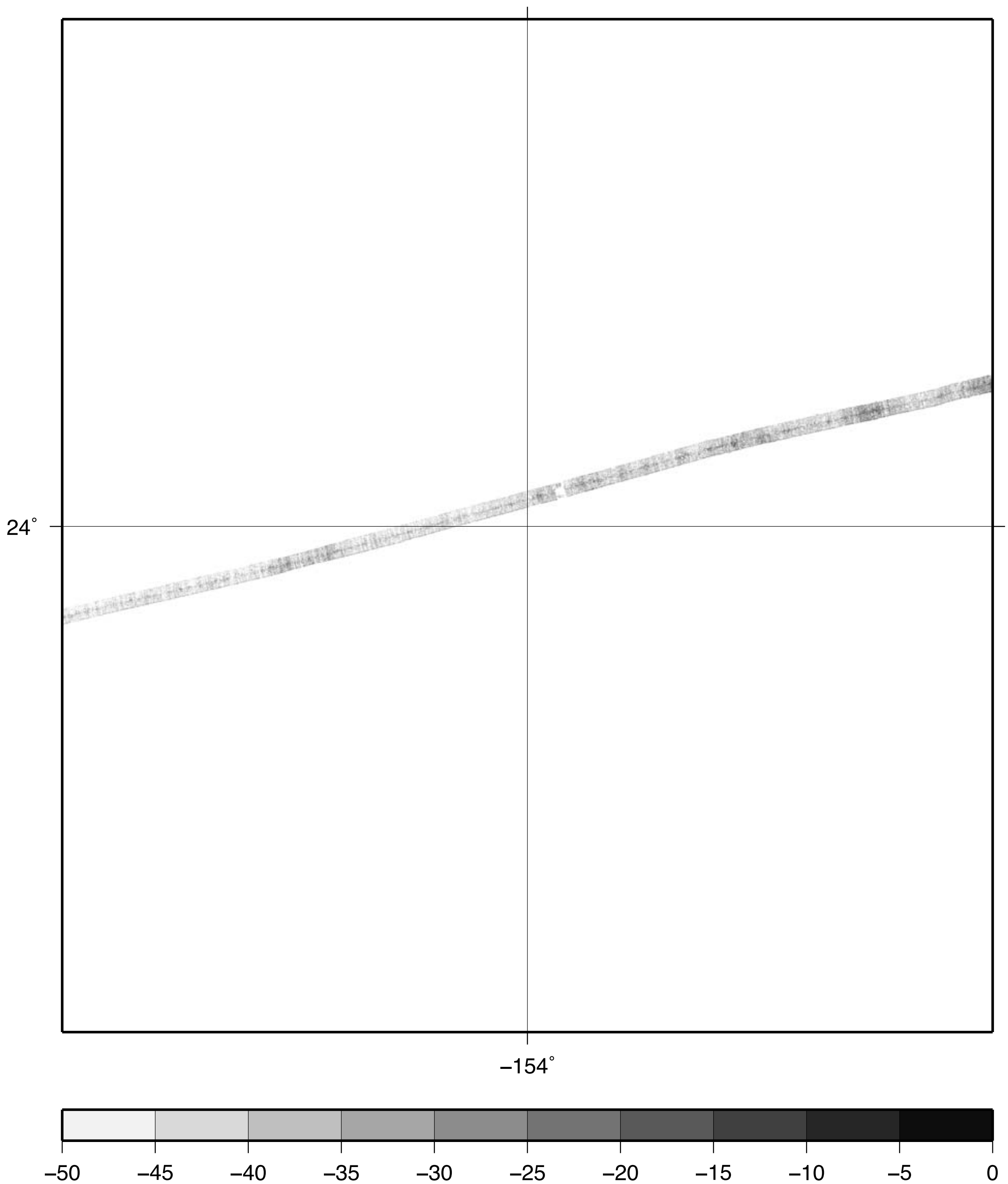


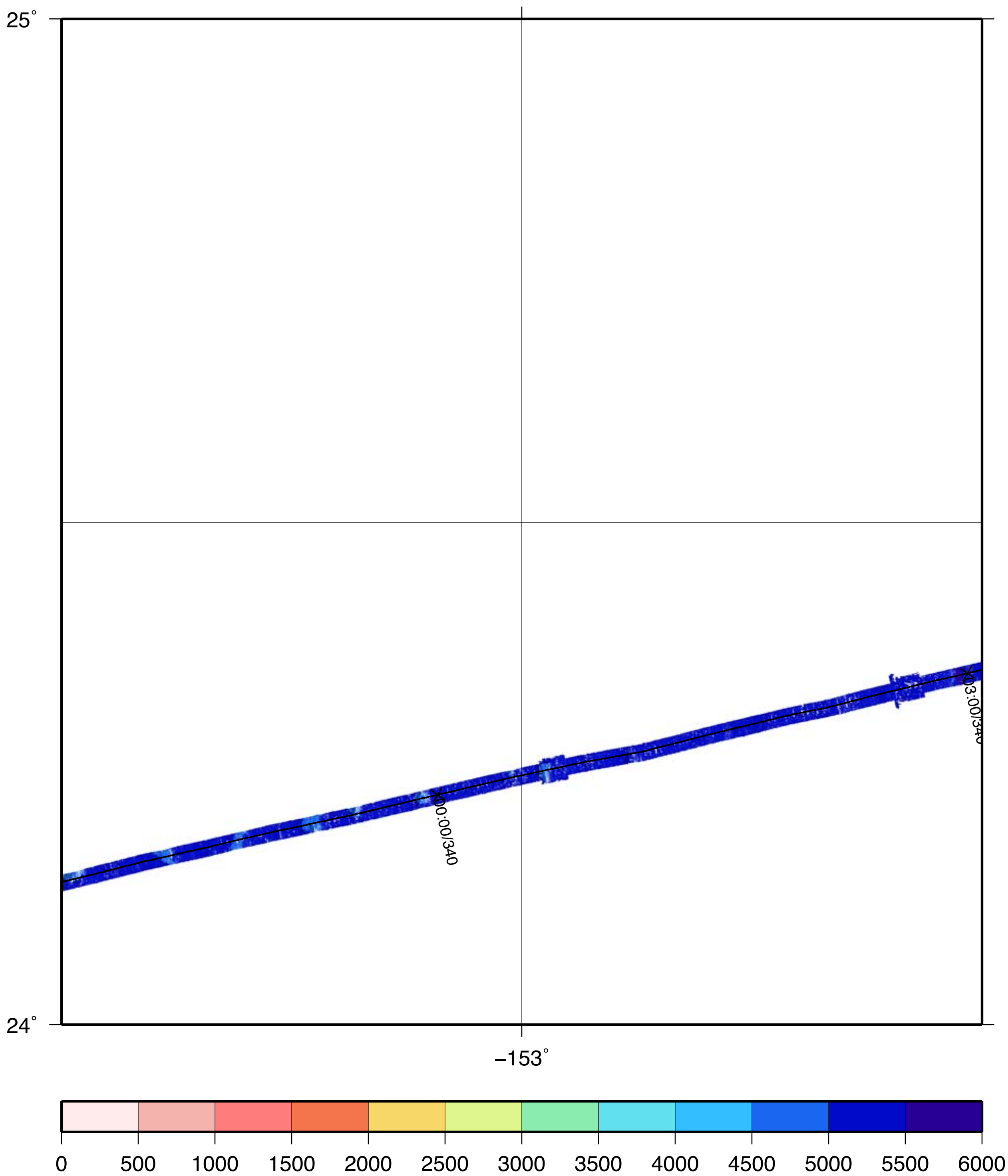
24˚
−155˚
09:00/339
12:00/339
15:00/339
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000


24˚
−155˚
−50
−45
−40
−35
−30
−25
−20
−15
−10
−5
0

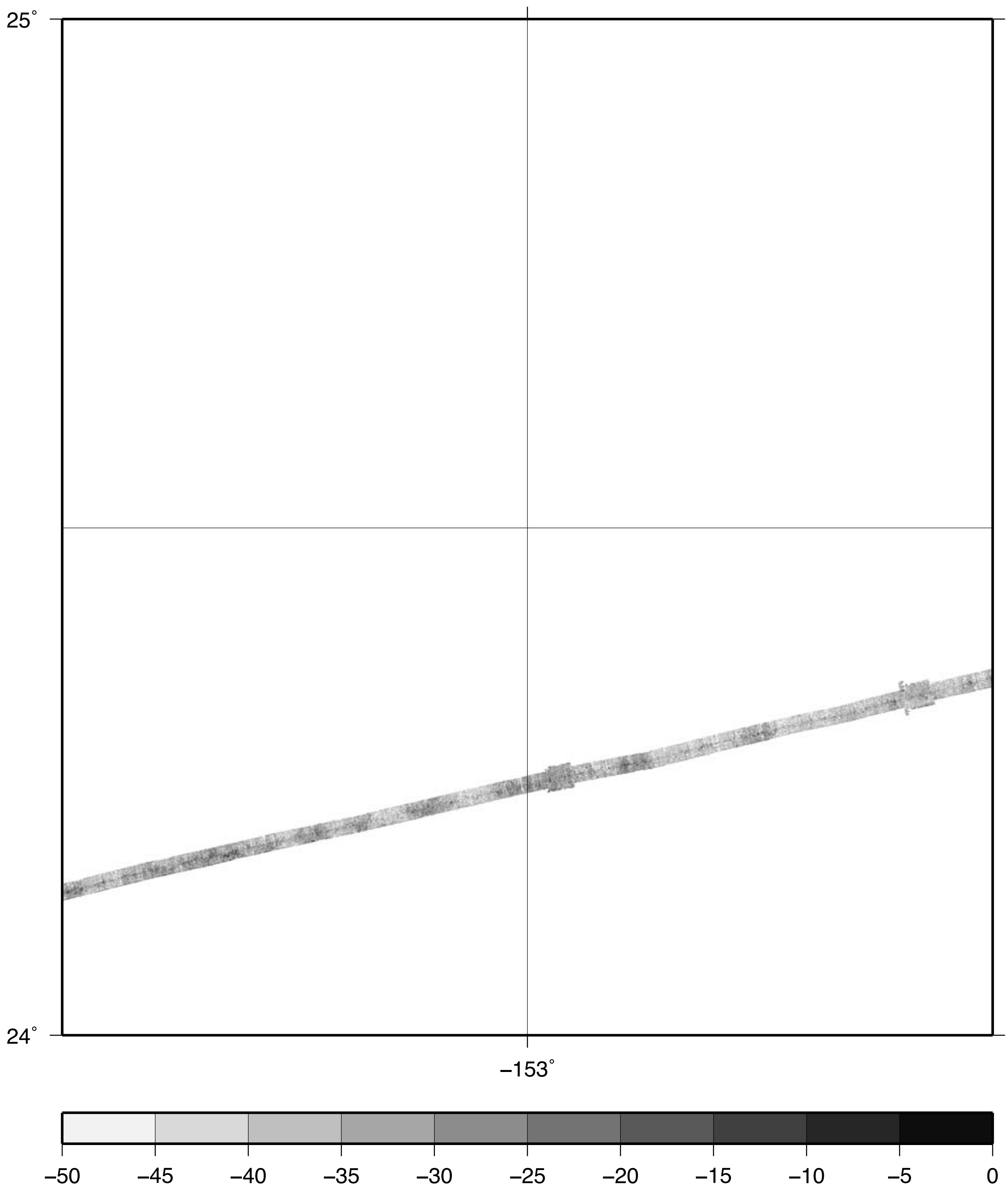


24˚
–154˚
18:00/339
21:00/339
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000

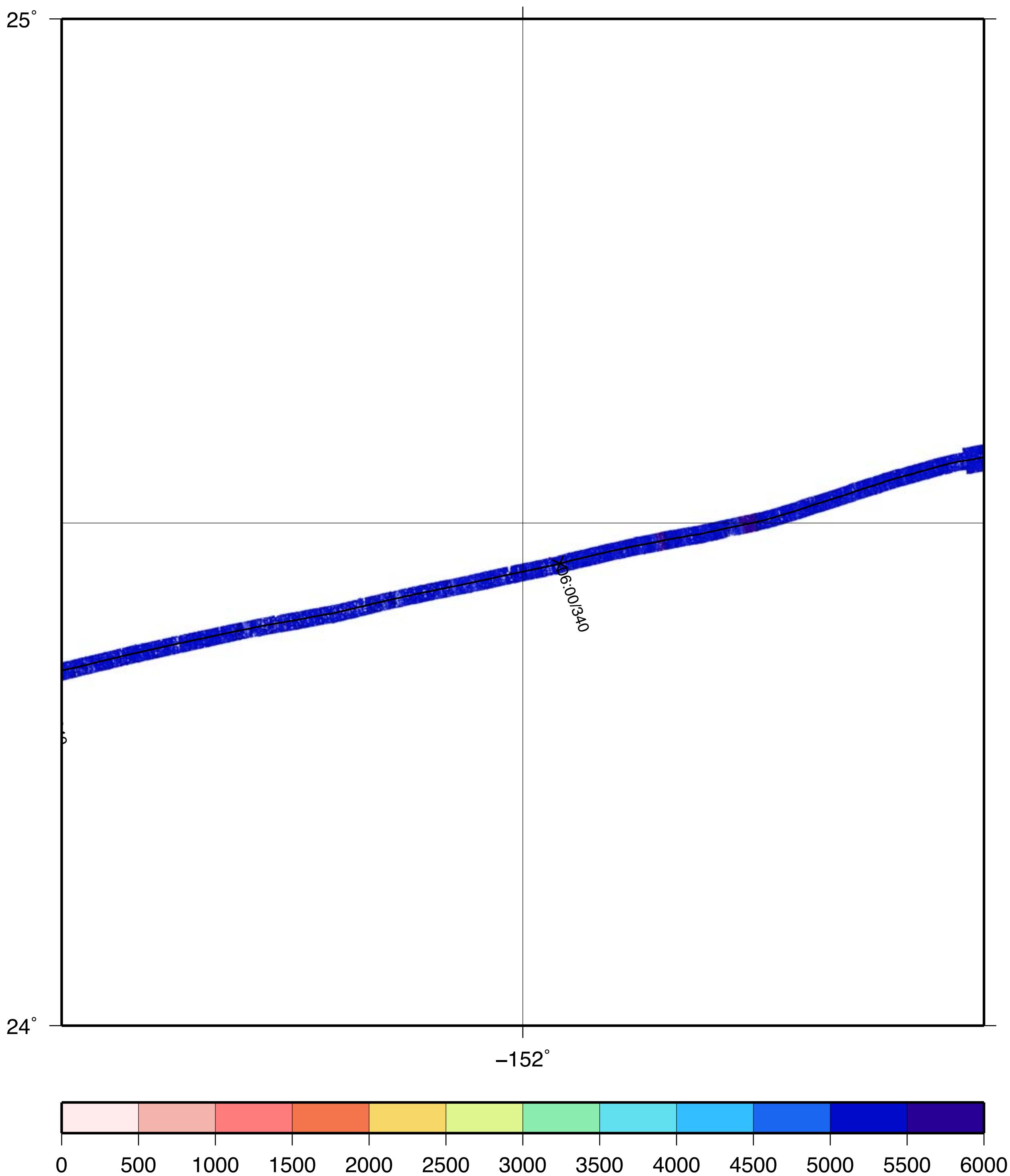

24˚
−154˚
−50
−45
−40
−35
−30
−25
−20
−15
−10
−5
0



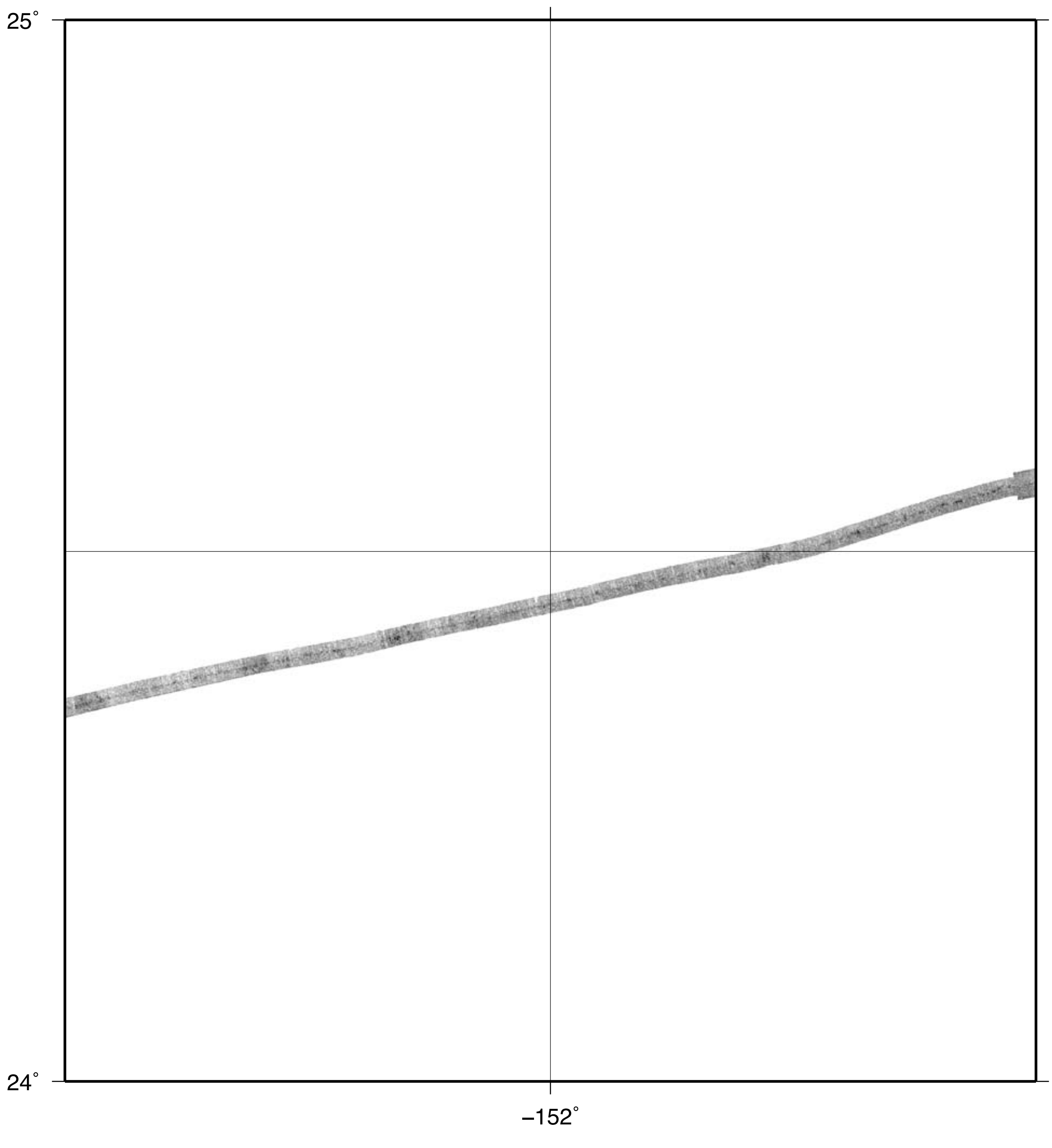
25˚
24˚
−153˚
00:00/340
03:00/340
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000

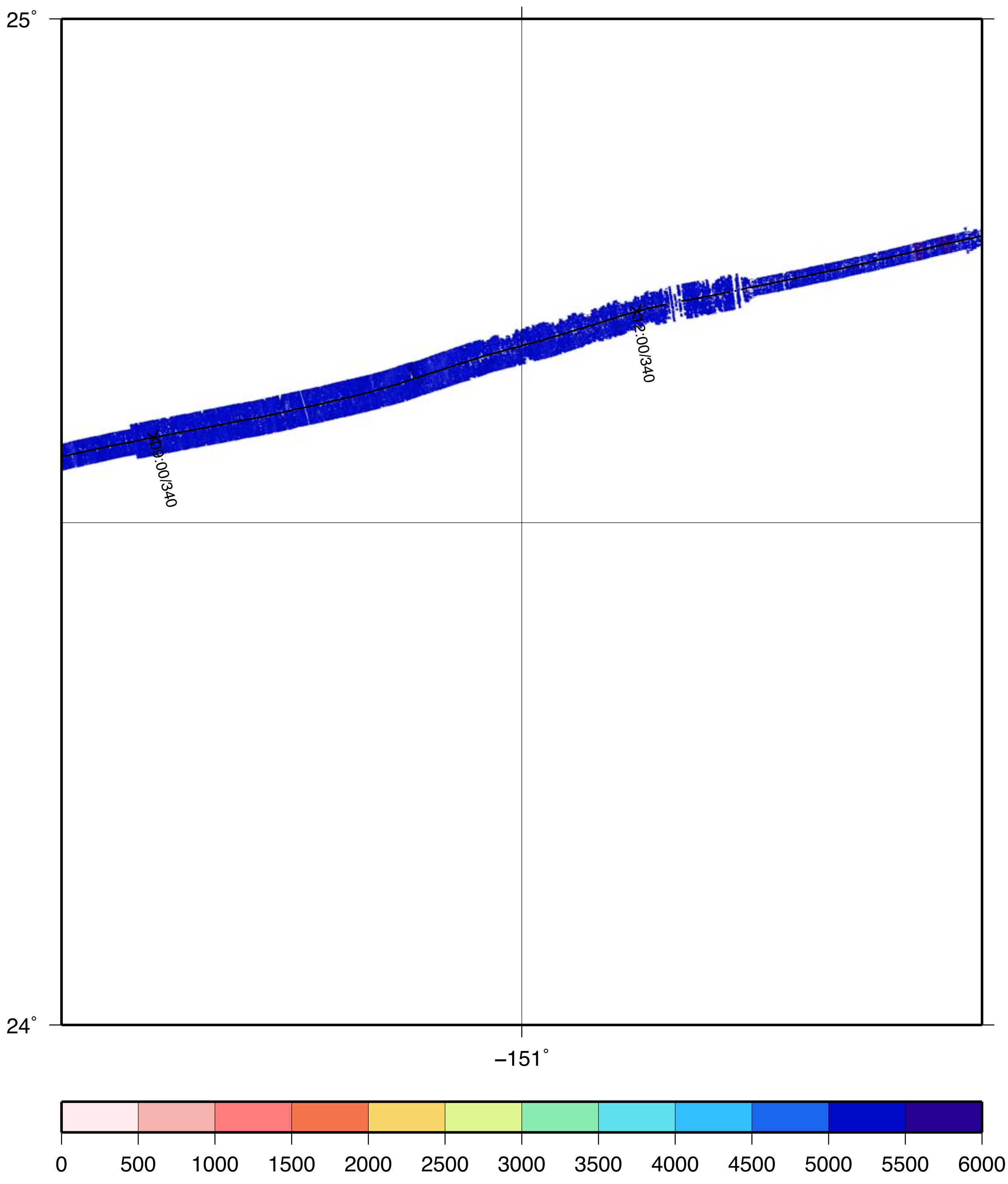


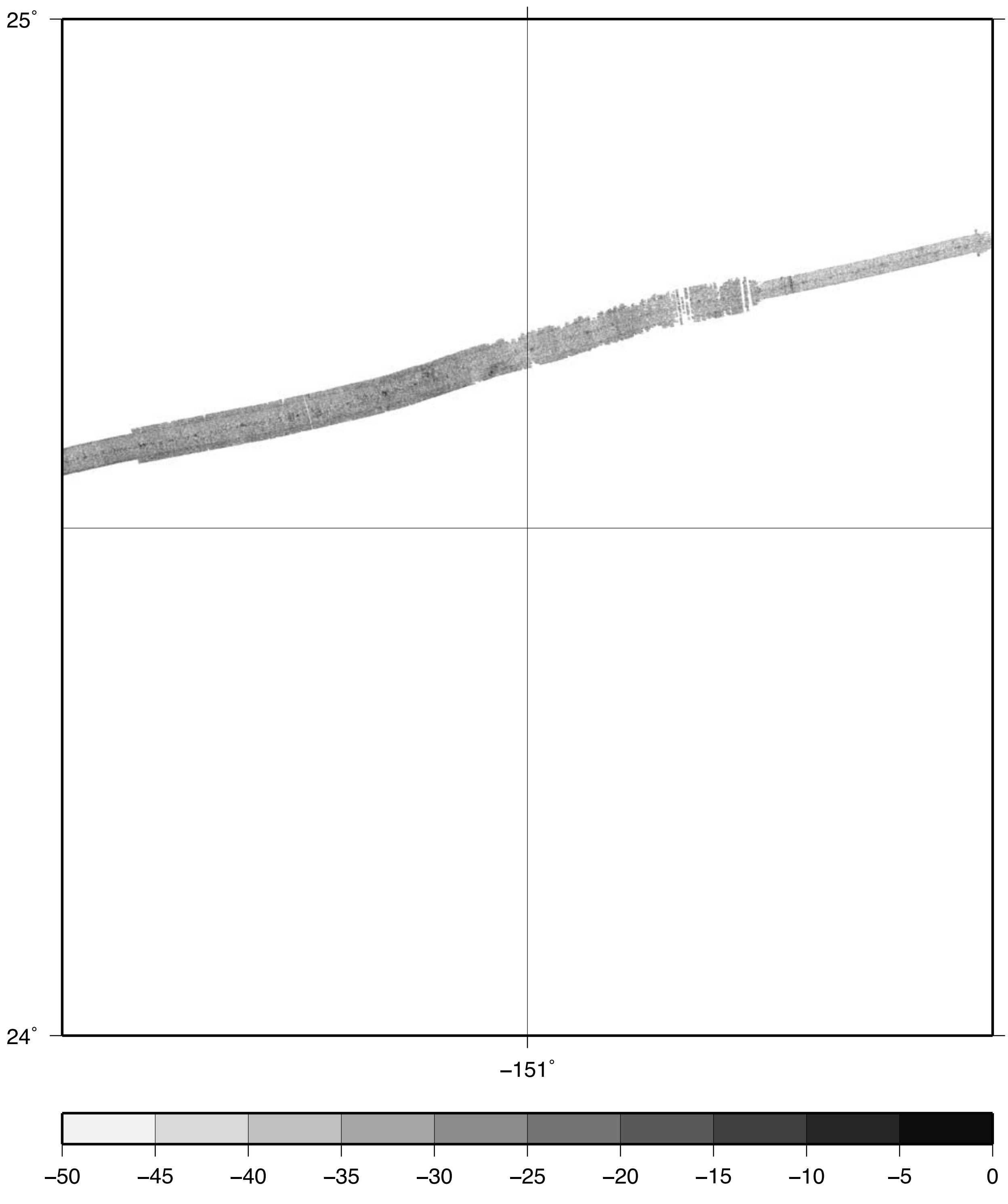
25°
24°
−153°
−50
−45
−40
−35
−30
−25
−20
−15
−10
−5
0



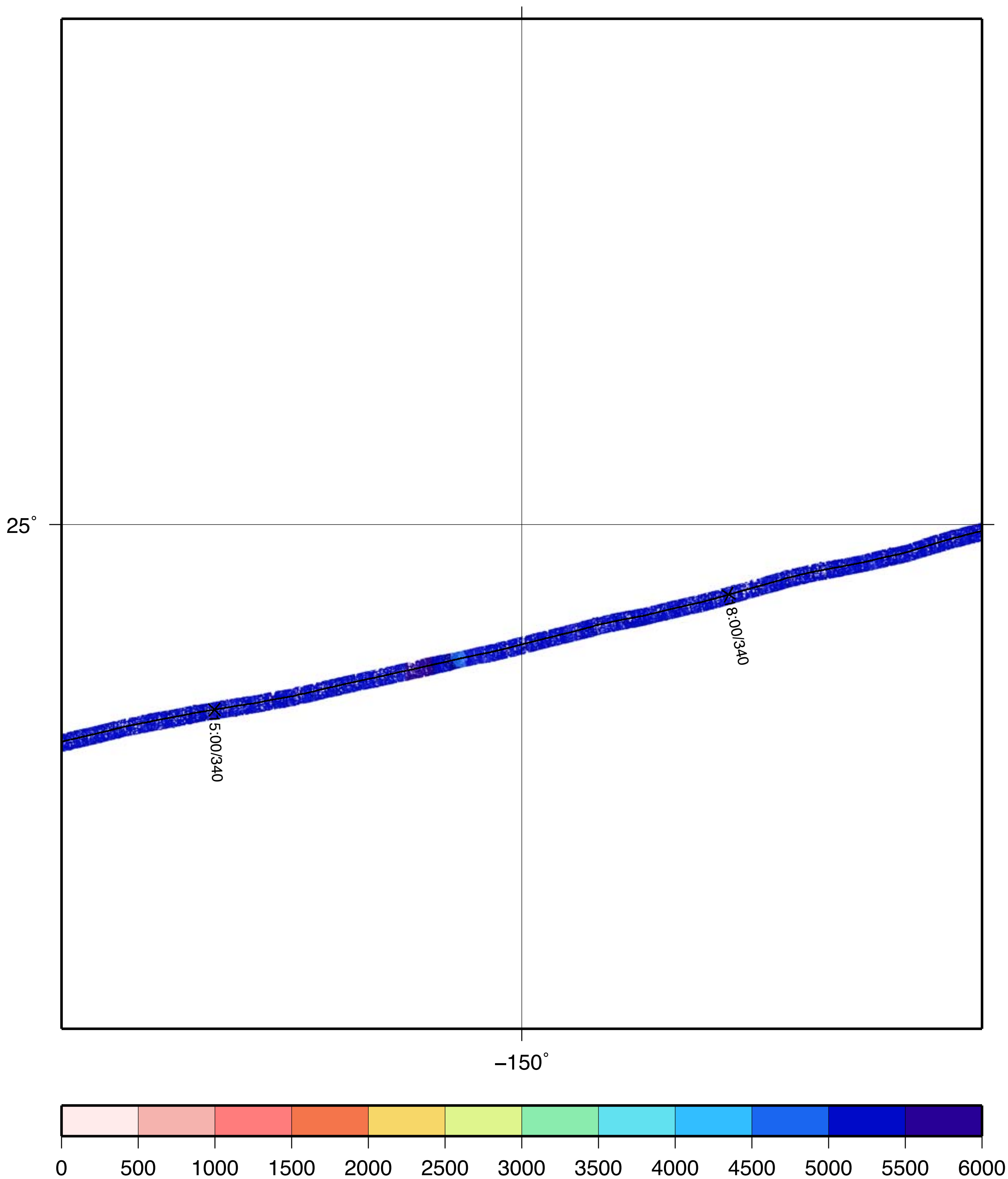
25˚
24˚
−152˚
06:00/340
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000

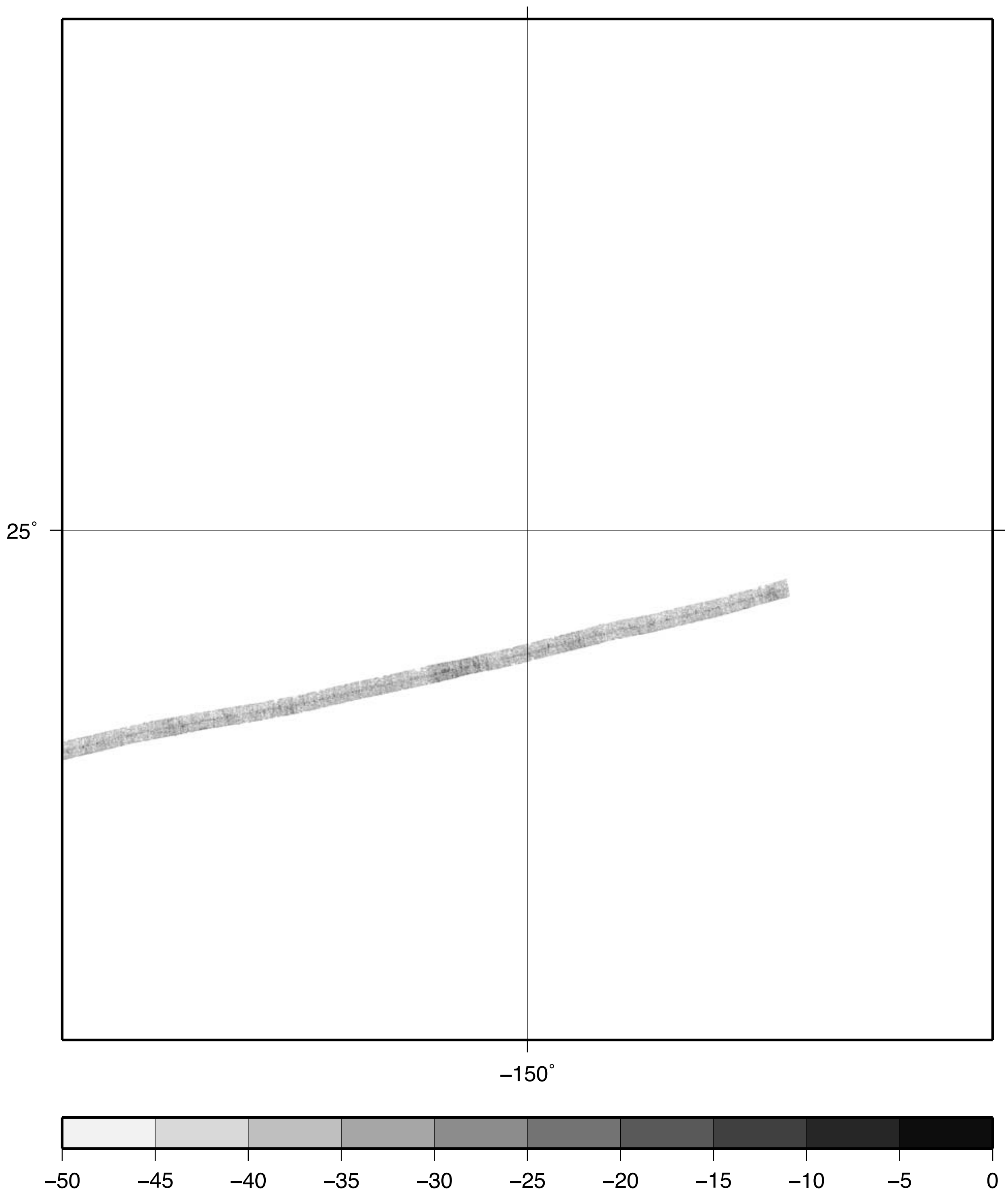

25°
24°
−152°
−50
−45
−40
−35
−30
−25
−20
−15
−10
−5
0

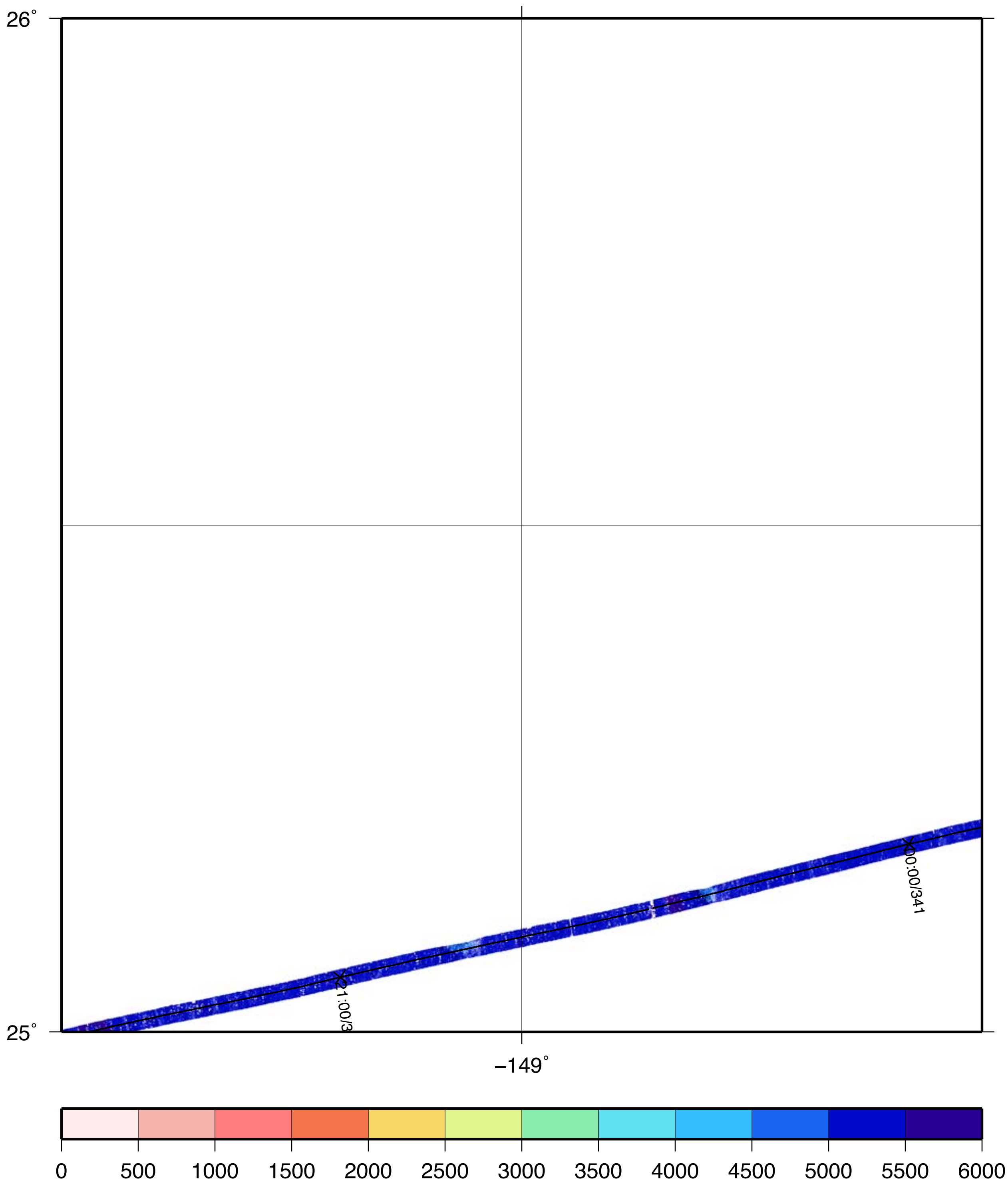

25°
24°
−151°
09:00/340
12:00/340
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000



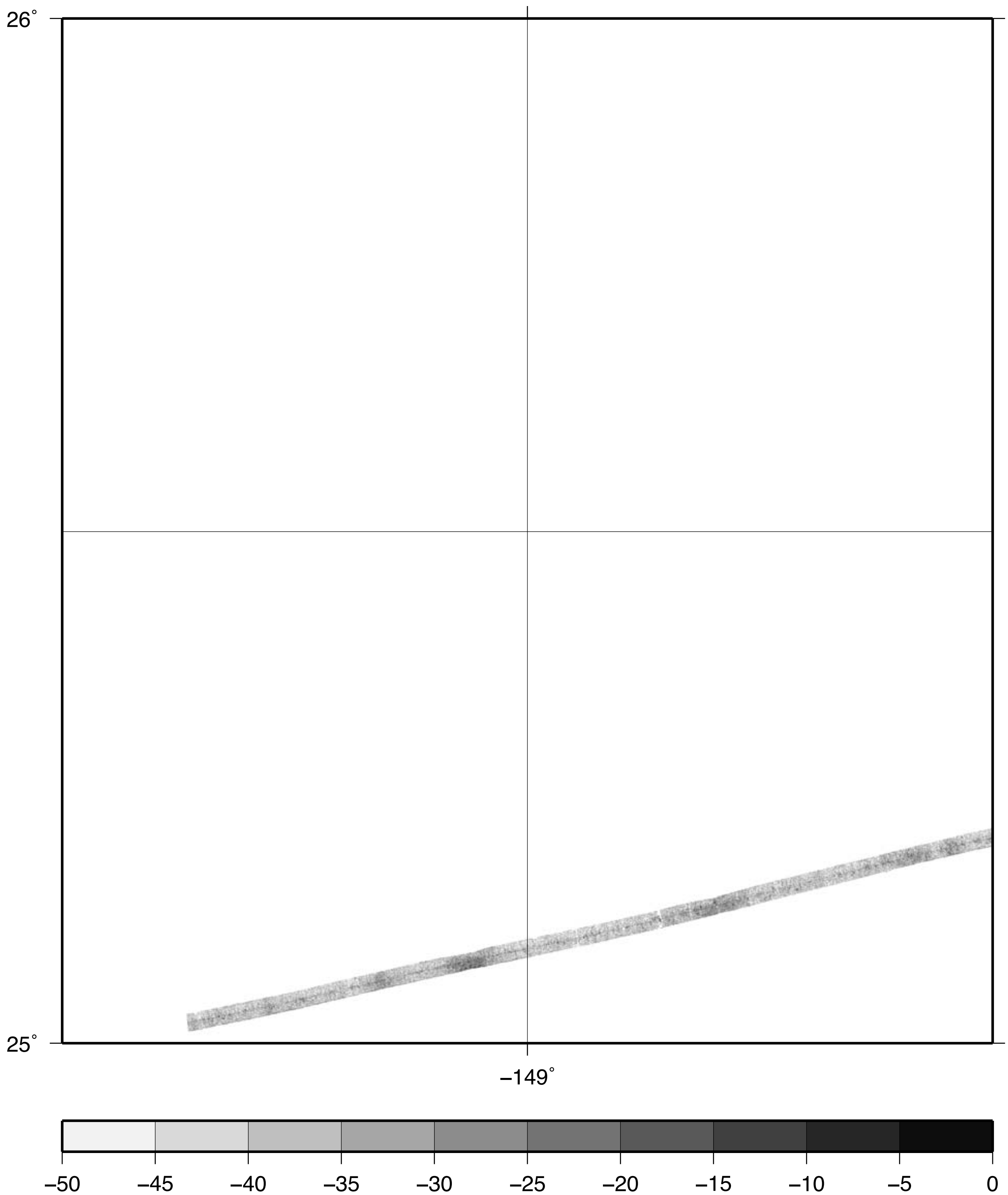
25˚
24˚
−151˚
−50
−45
−40
−35
−30
−25
−20
−15
−10
−5
0

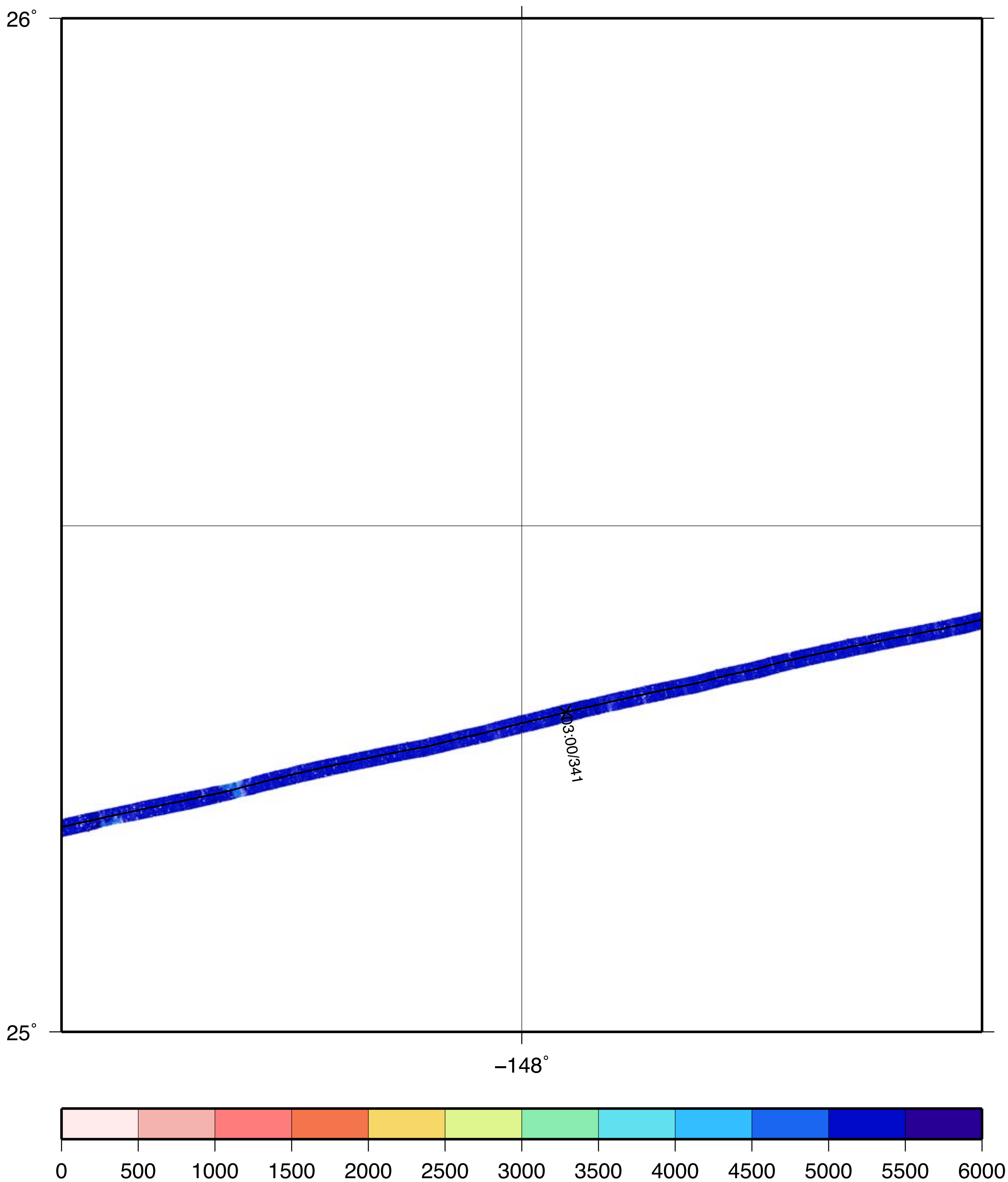

25˚
−150˚
15:00/340
18:00/340
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000


25˚
−150˚
−50
−45
−40
−35
−30
−25
−20
−15
−10
−5
0

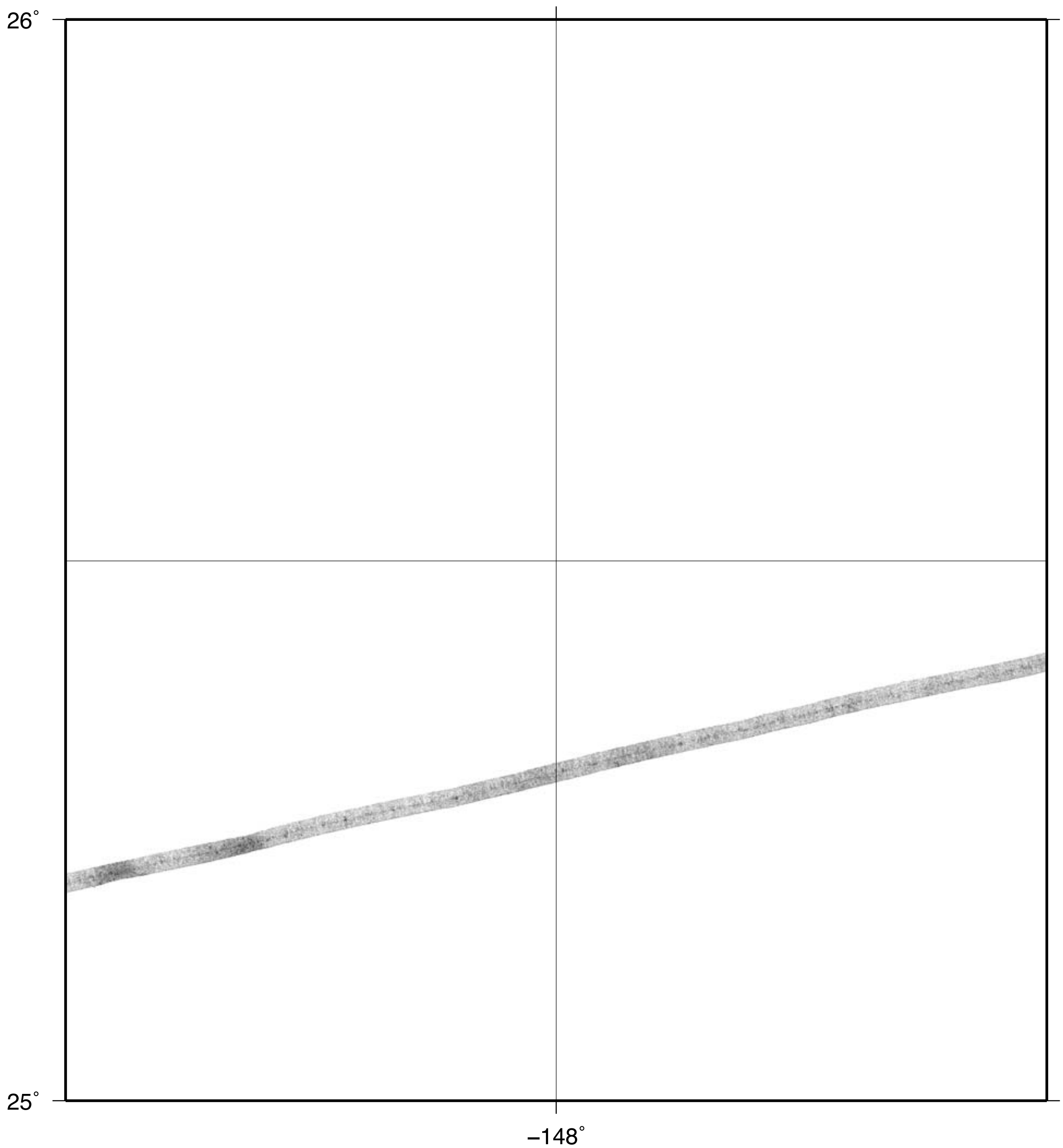


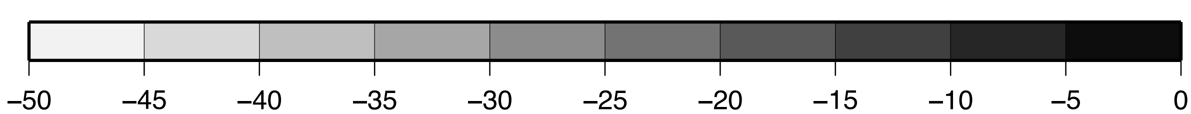
26˚
25˚
−149˚
21:00/3
00:00/341
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000

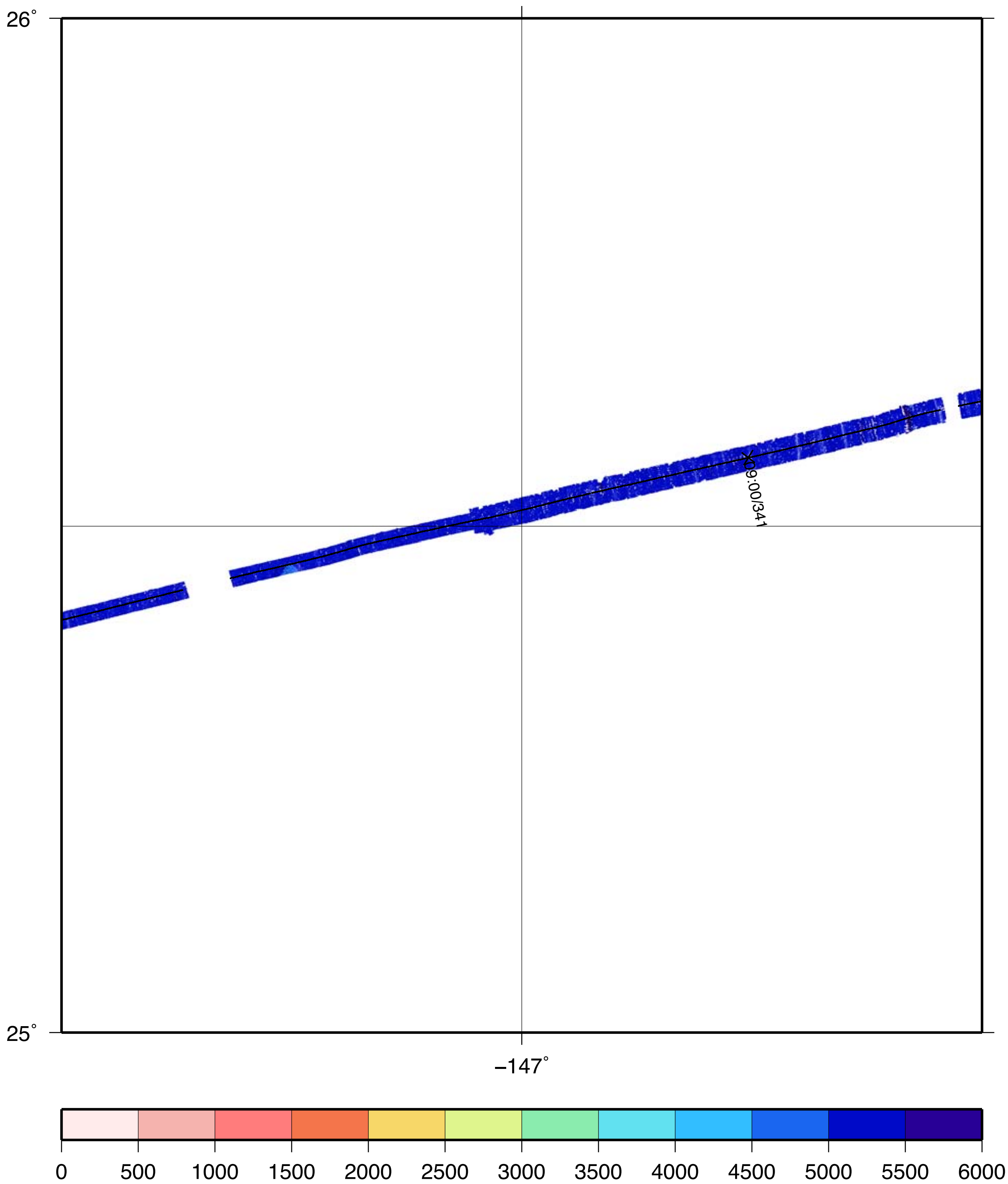

26°
25°
−149°
−50
−45
−40
−35
−30
−25
−20
−15
−10
−5
0

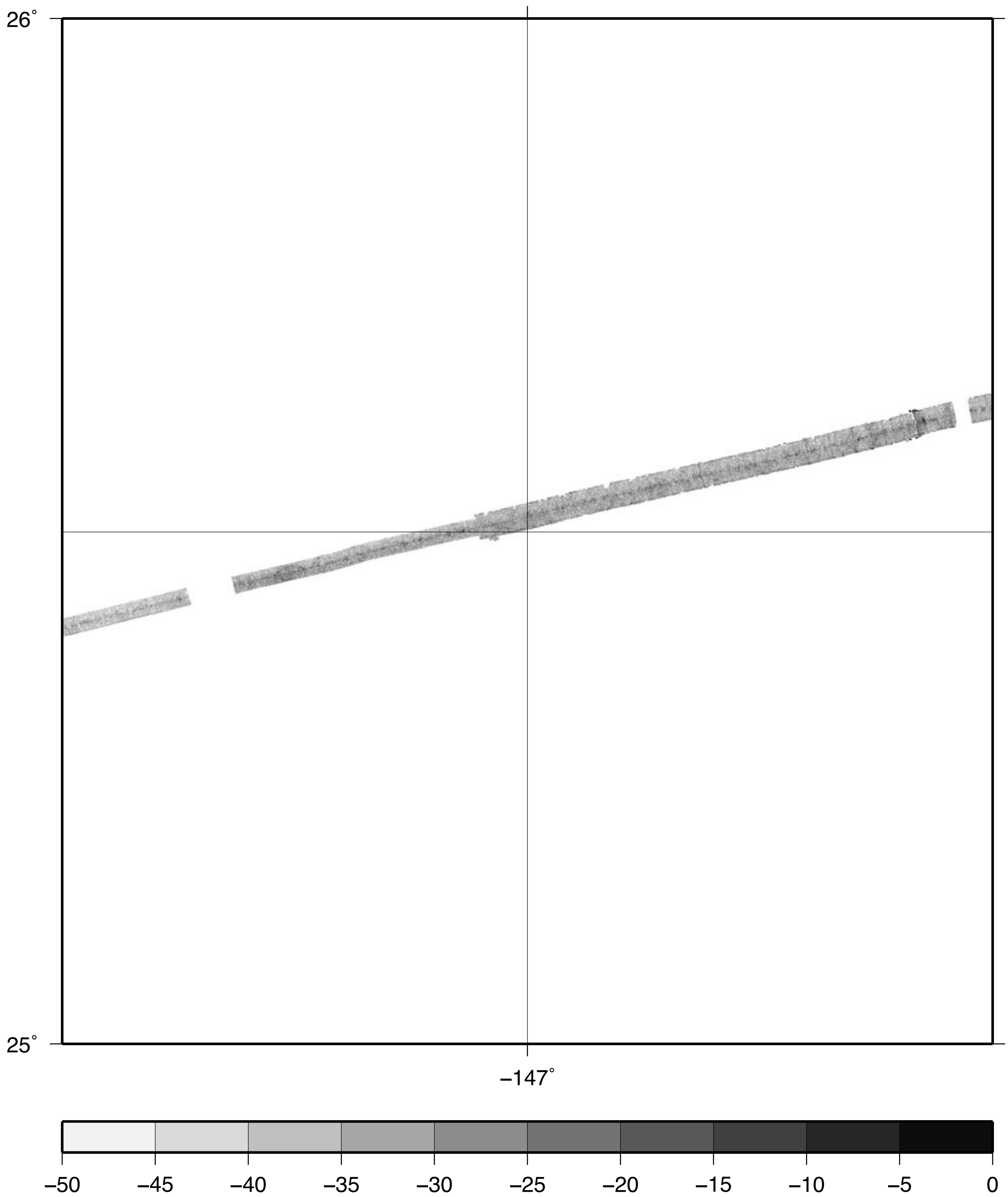


26˚
25˚
−148˚
03:00/341
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000

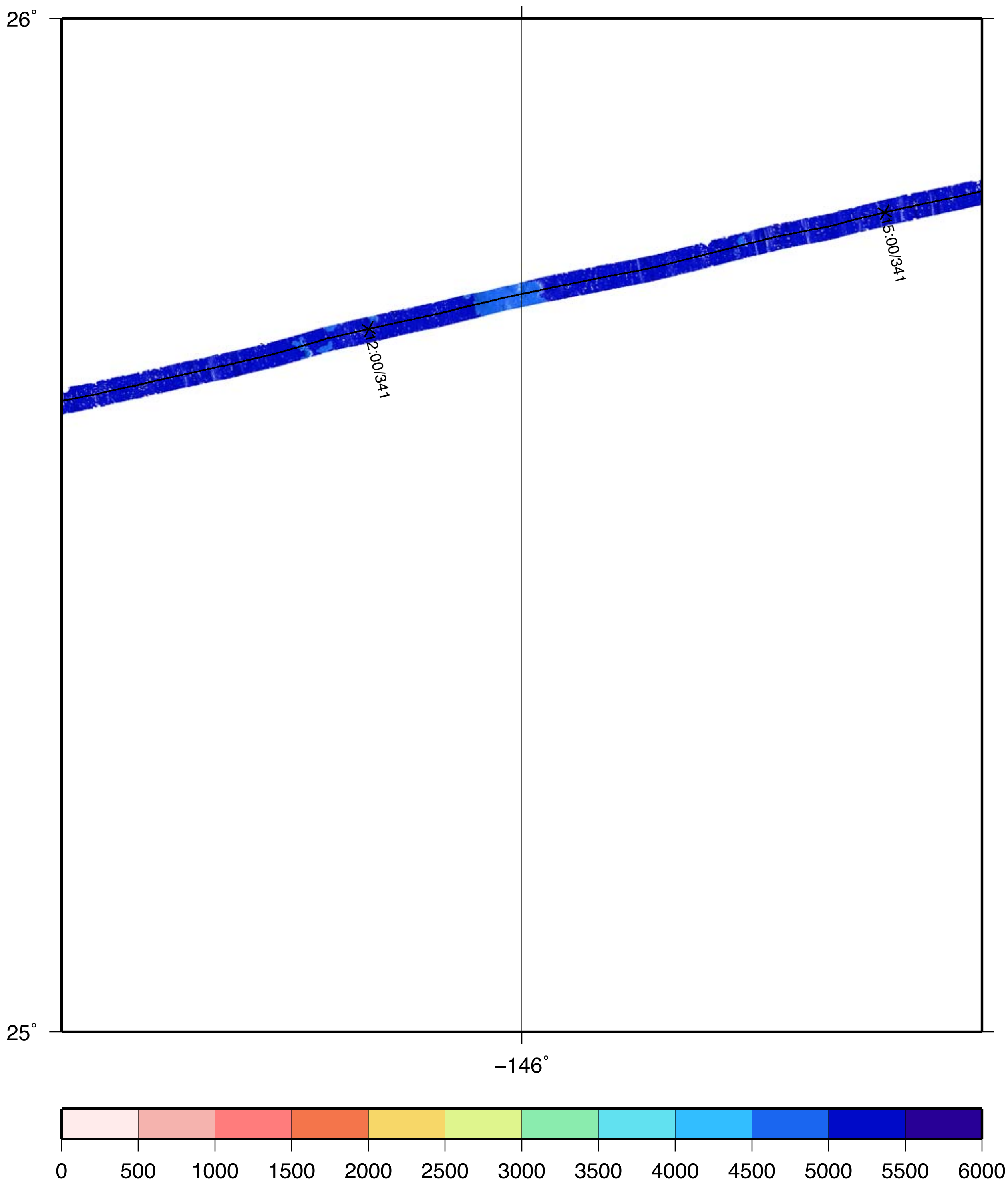

26˚
25˚
−148˚

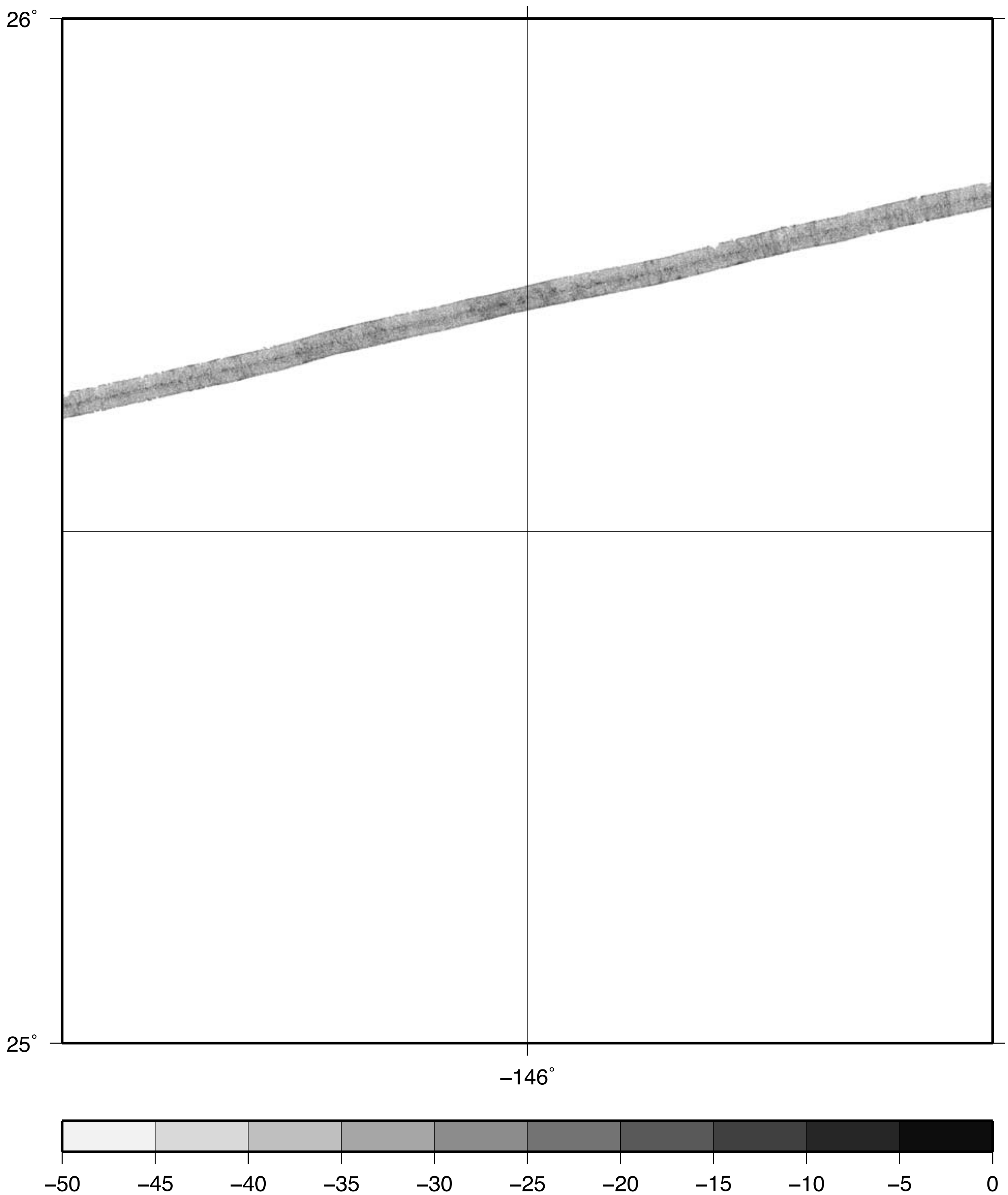

−50 −45 −40 −35 −30 −25 −20 −15 −10 −5 0

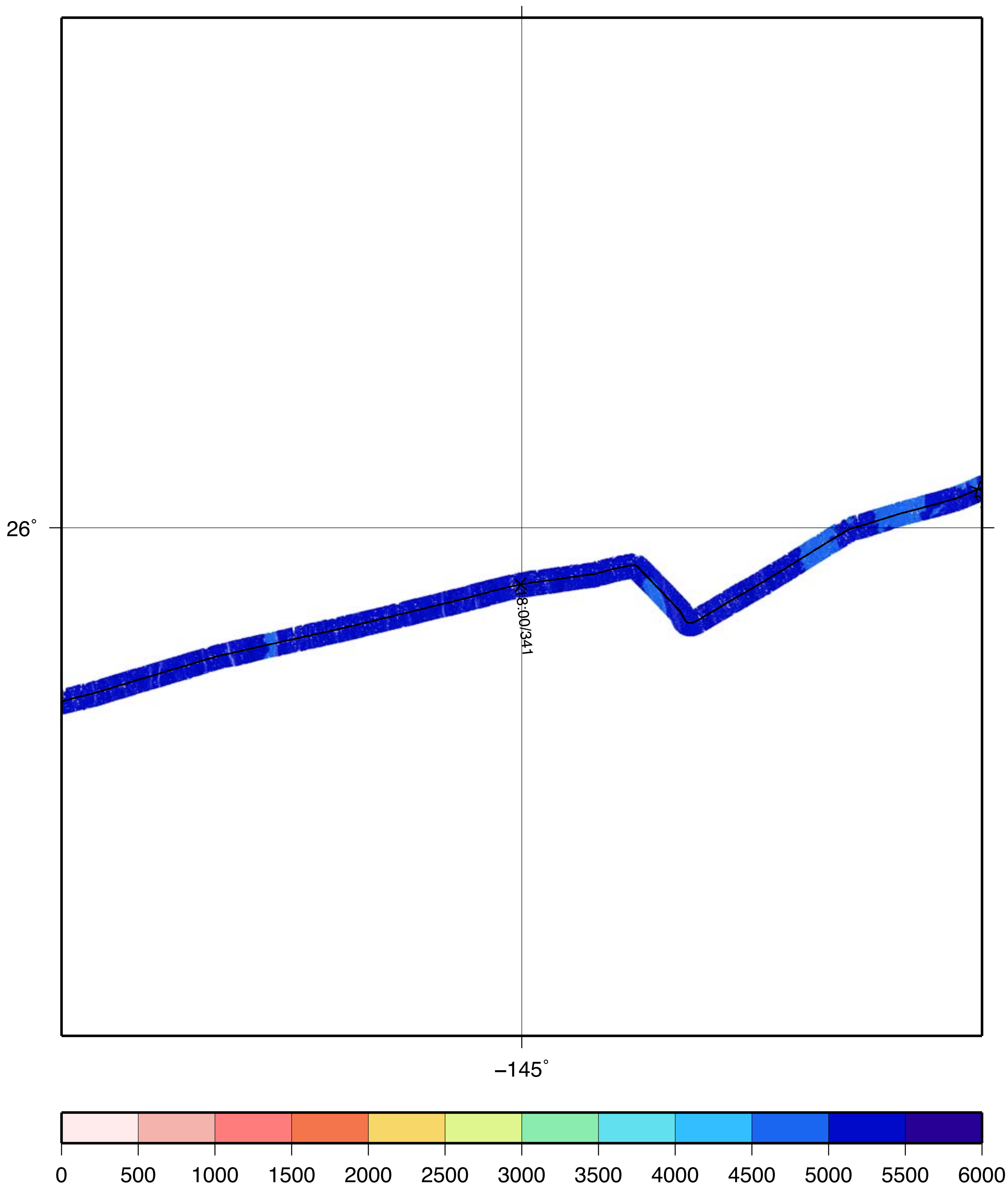

26˚
25˚
−147˚
09:00/341
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000



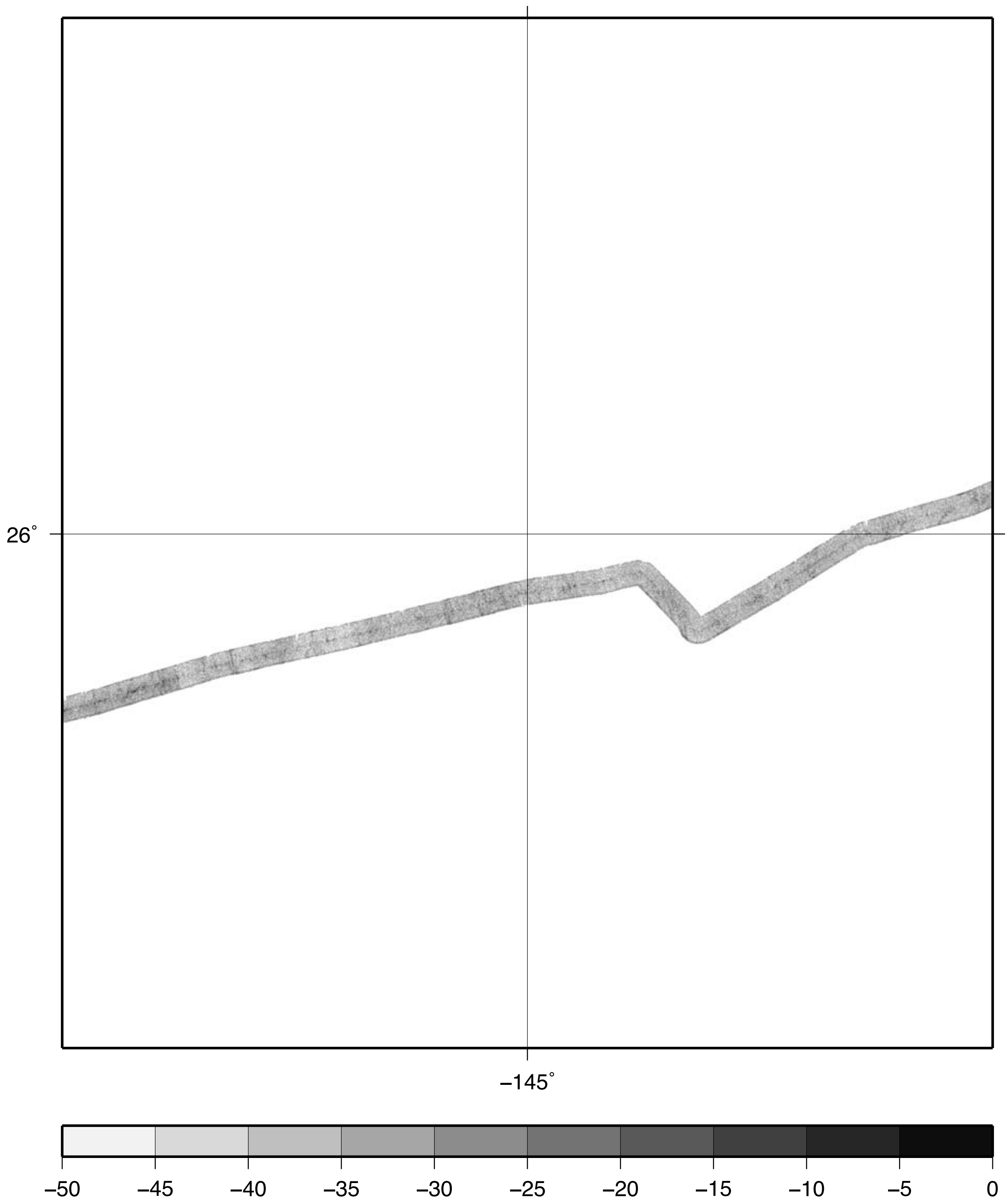
26°
25°
−147°
−50
−45
−40
−35
−30
−25
−20
−15
−10
−5
0


26°
25°
−146°
2:00/341
5:00/341
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000

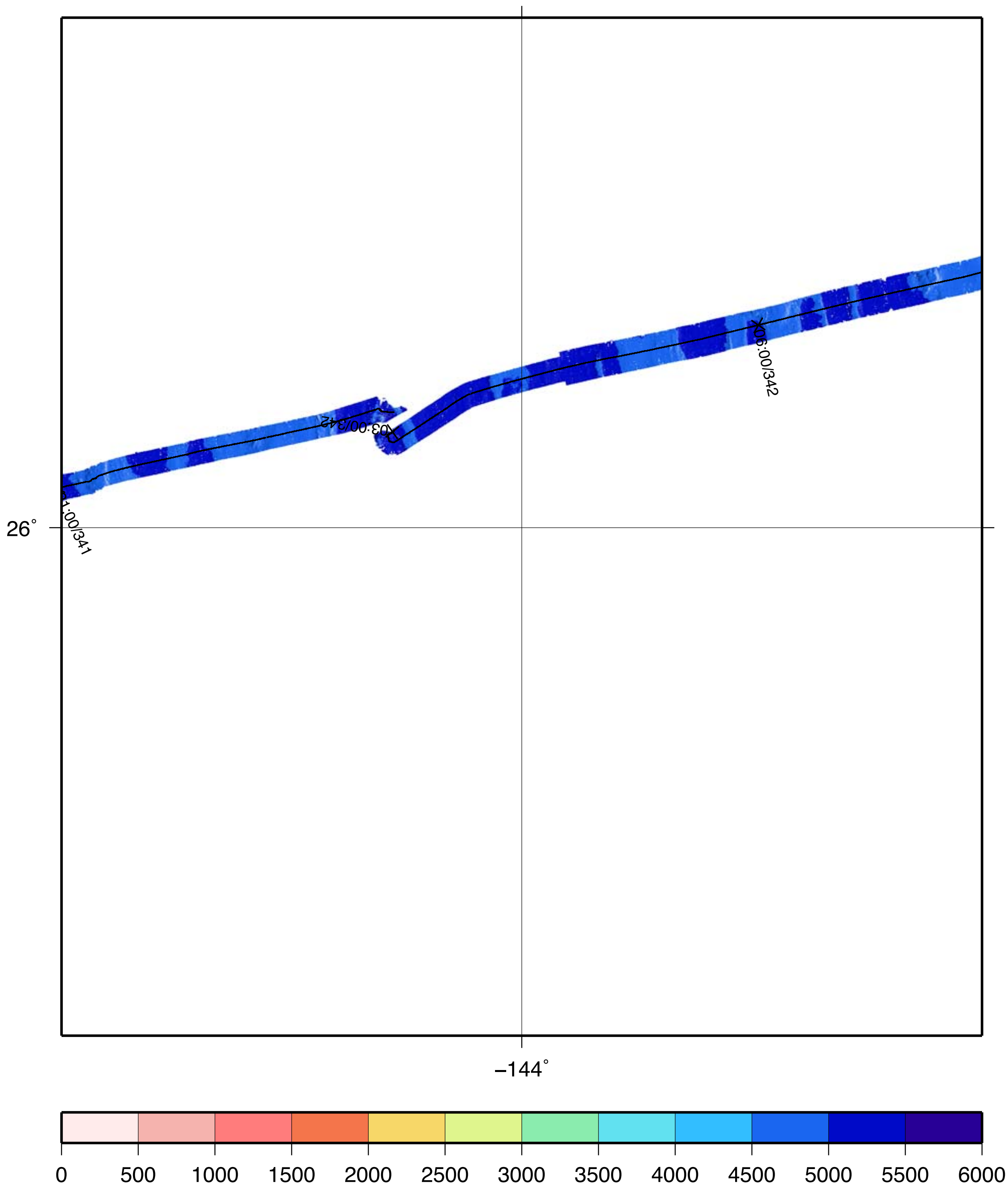

26˚
25˚
−146˚
−50
−45
−40
−35
−30
−25
−20
−15
−10
−5
0

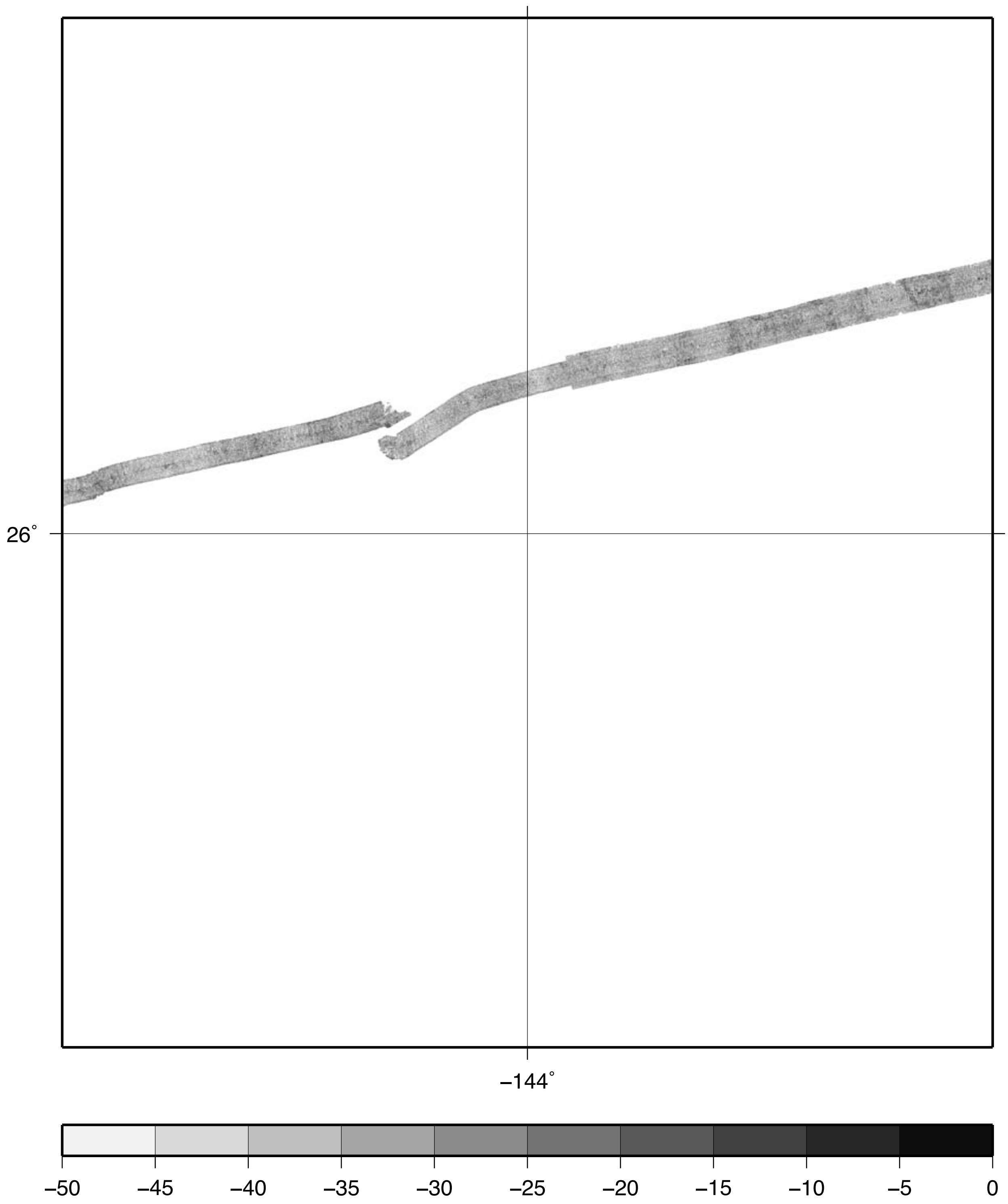


26˚
18:00/341
−145˚
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000

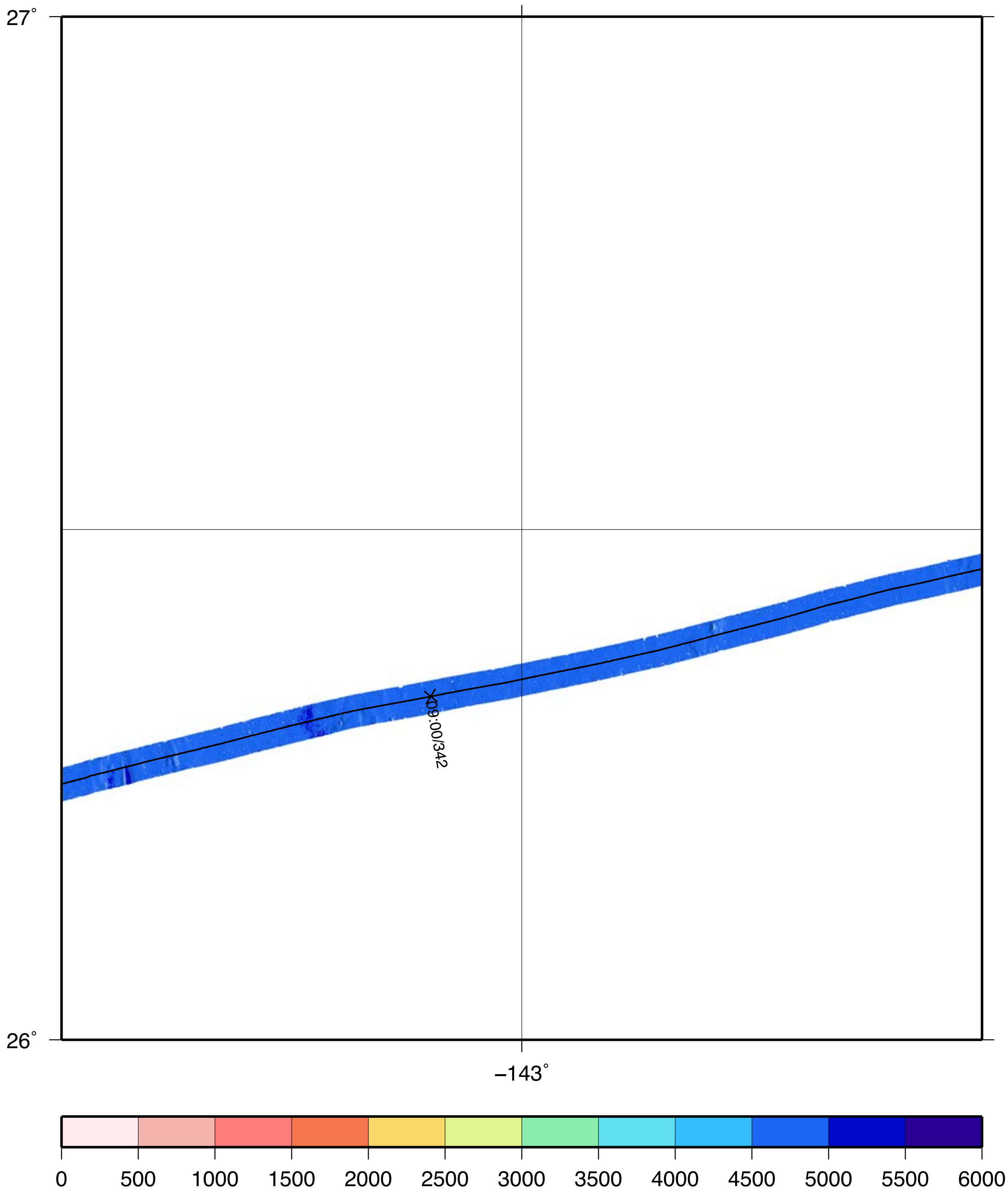


26˚
−145˚
−50
−45
−40
−35
−30
−25
−20
−15
−10
−5
0

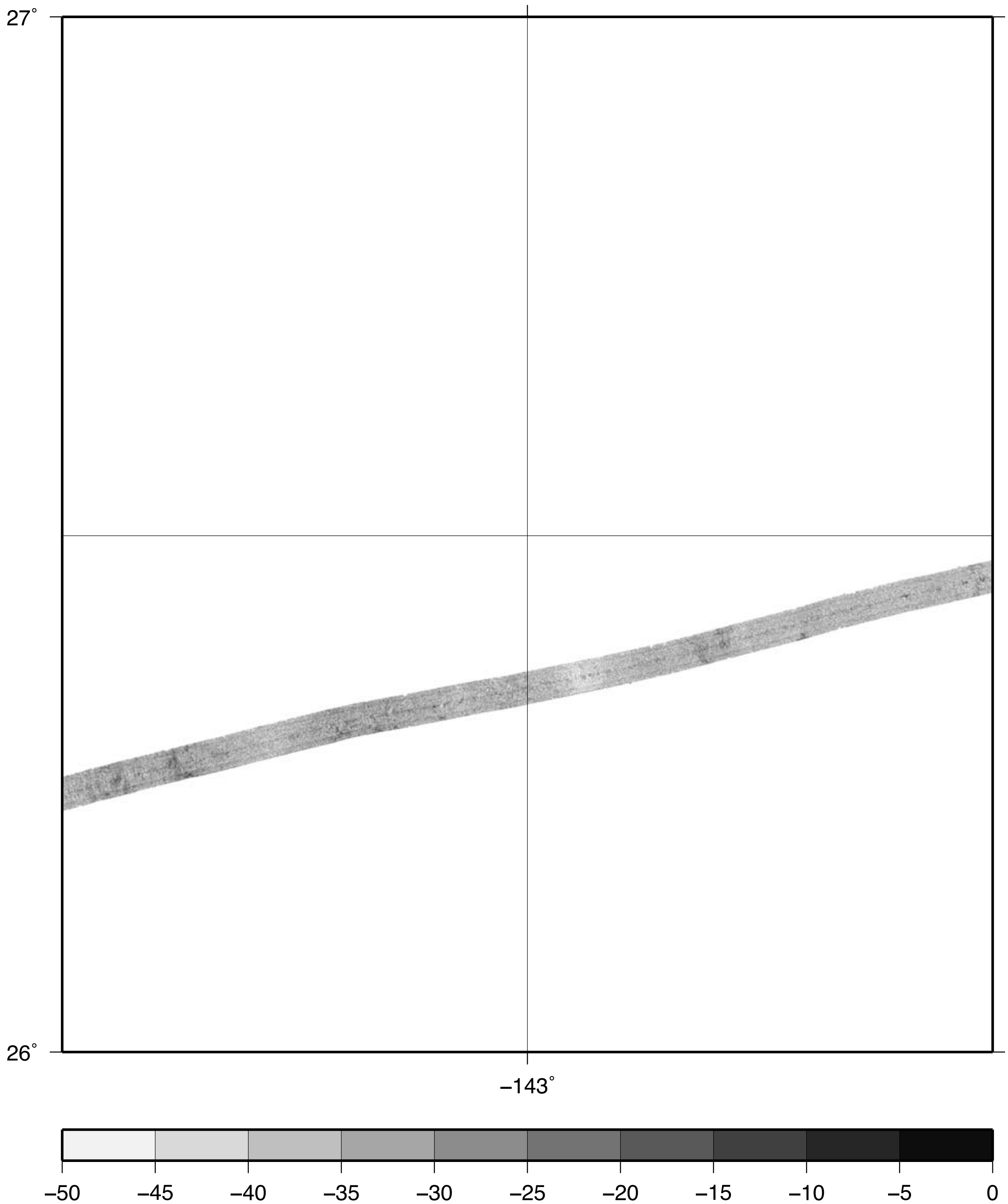

03:00/342
06:00/342
01:00/341
26°
−144°
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000

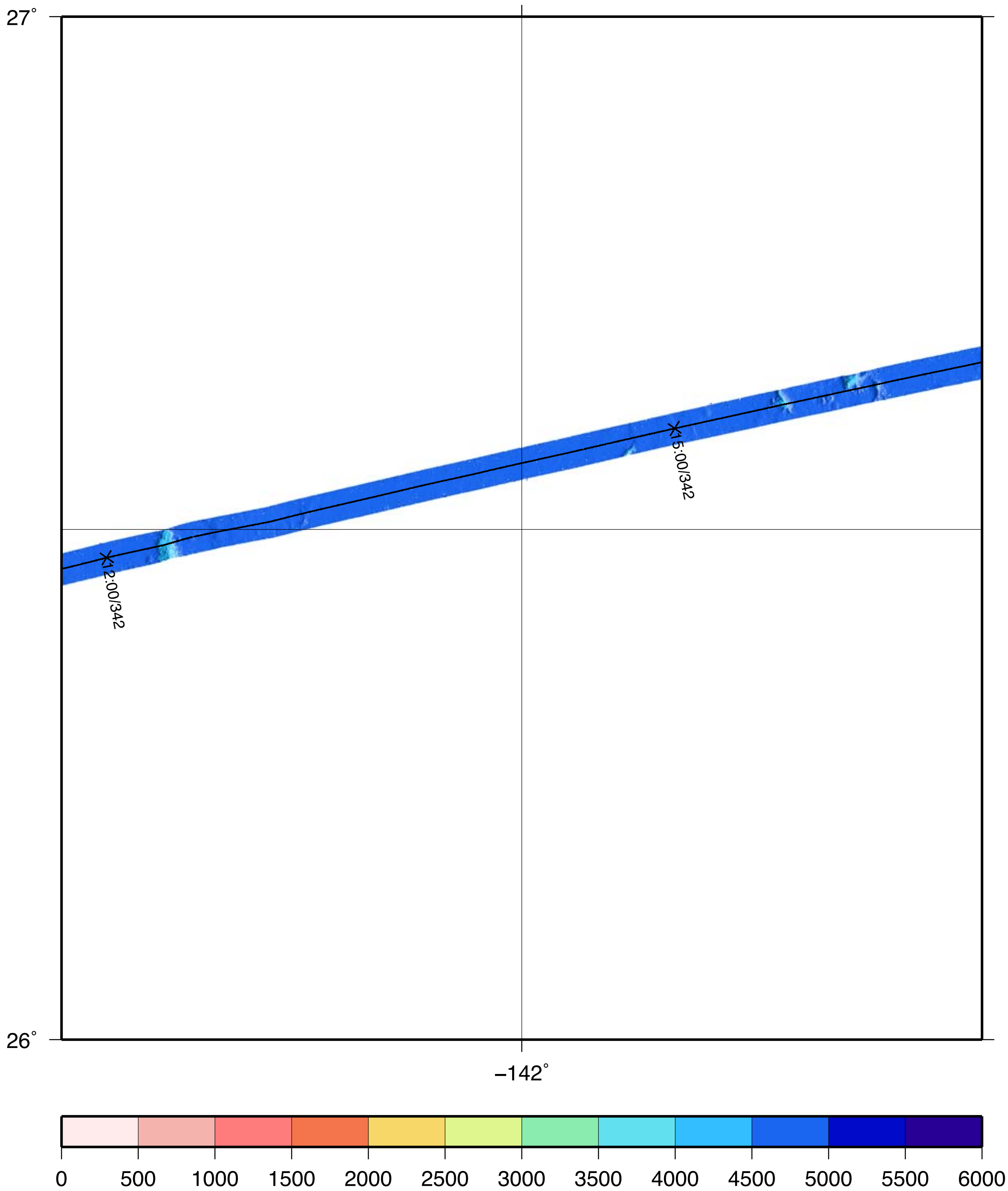


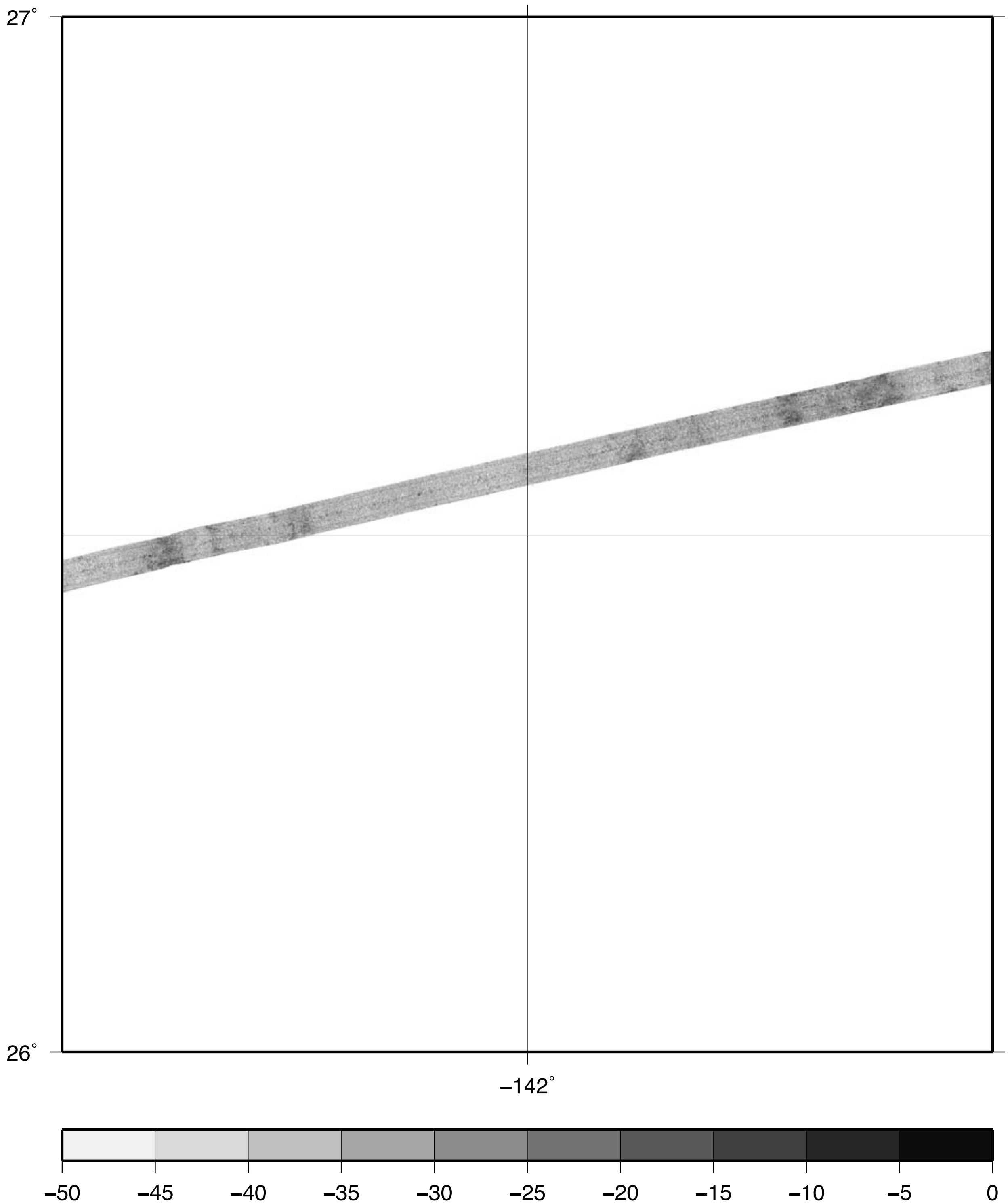
26˚
−144˚
−50
−45
−40
−35
−30
−25
−20
−15
−10
−5
0

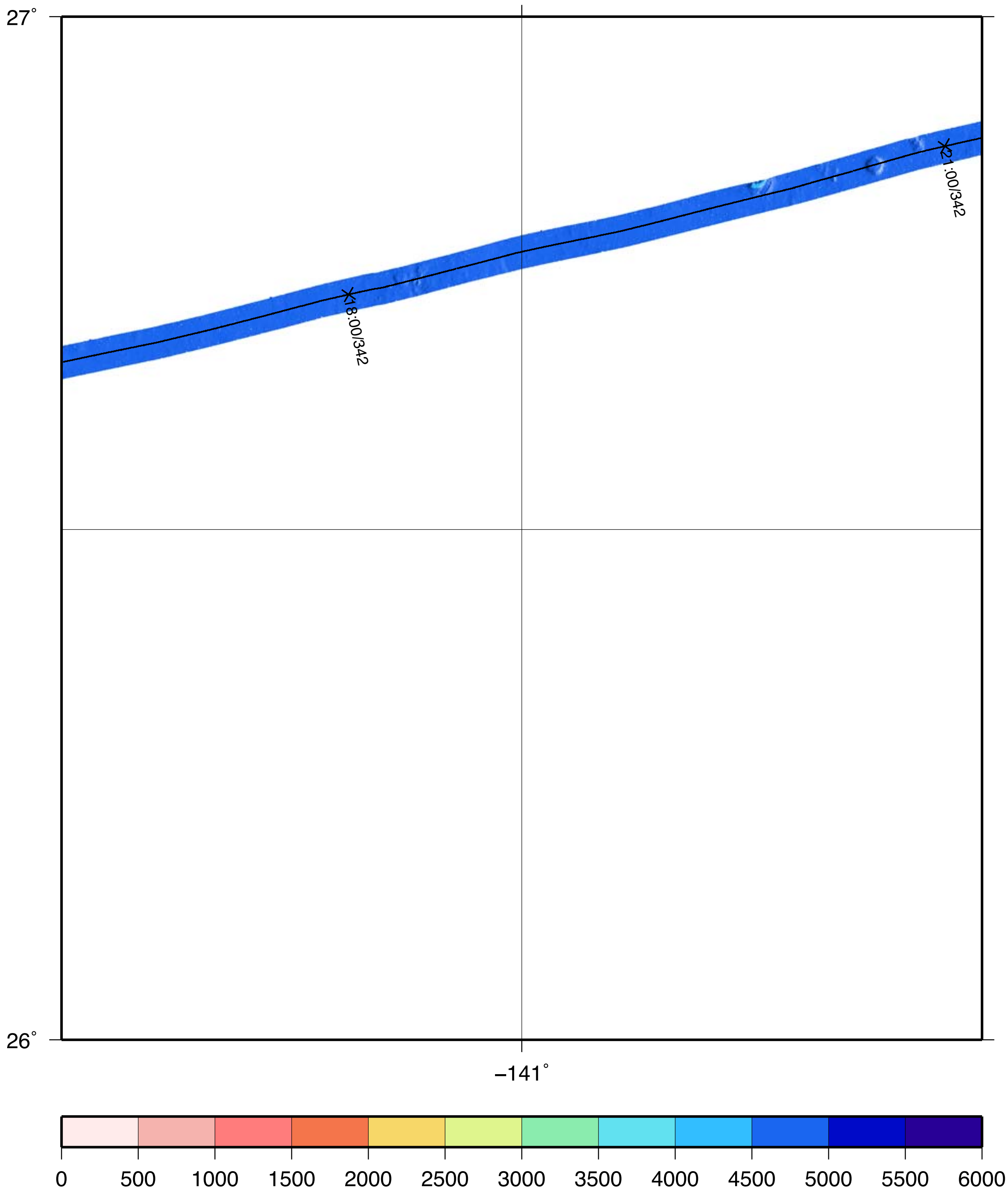


27˚
26˚
−143˚
09:00/342
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000

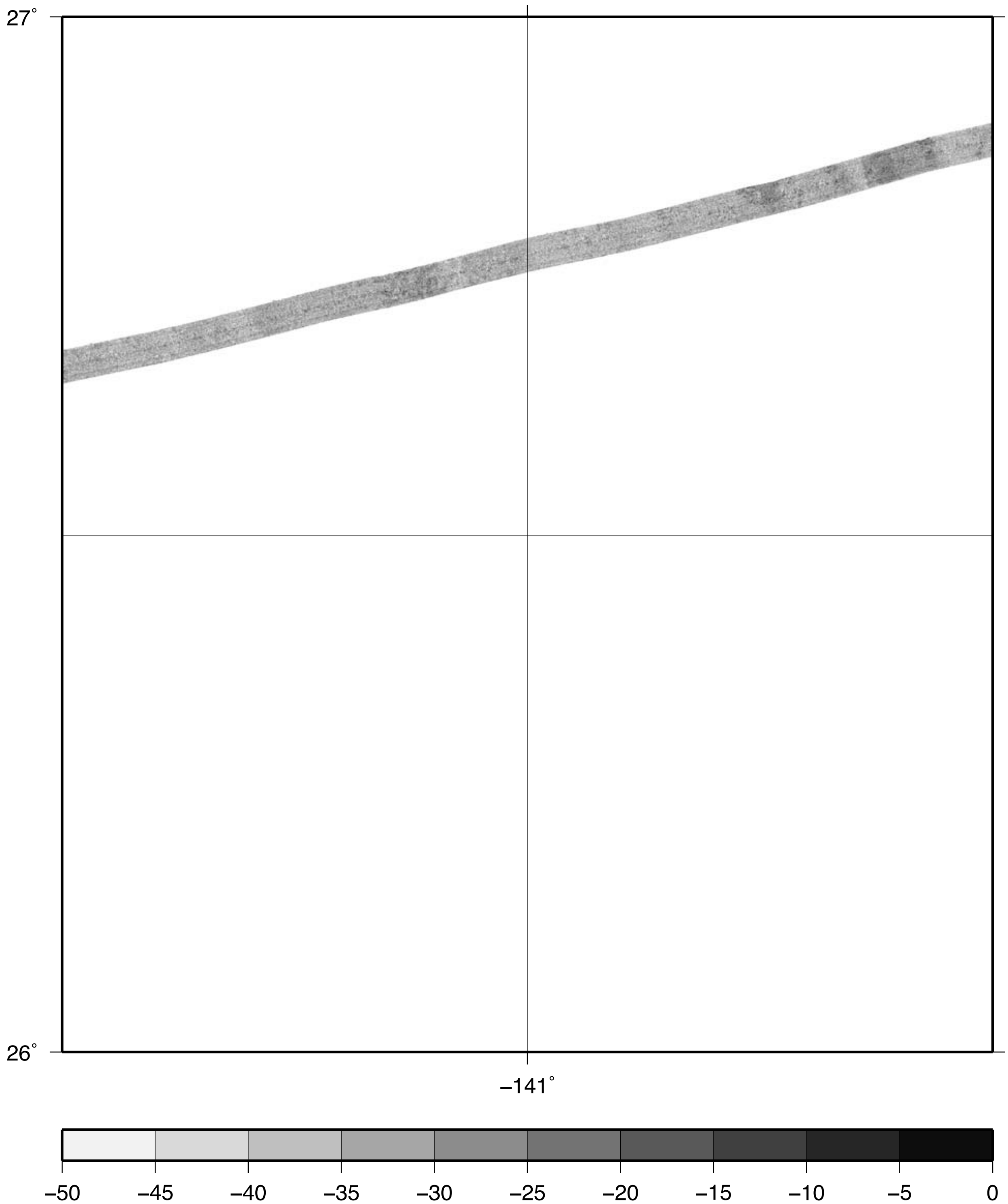

27°
26°
−143°
−50
−45
−40
−35
−30
−25
−20
−15
−10
−5
0

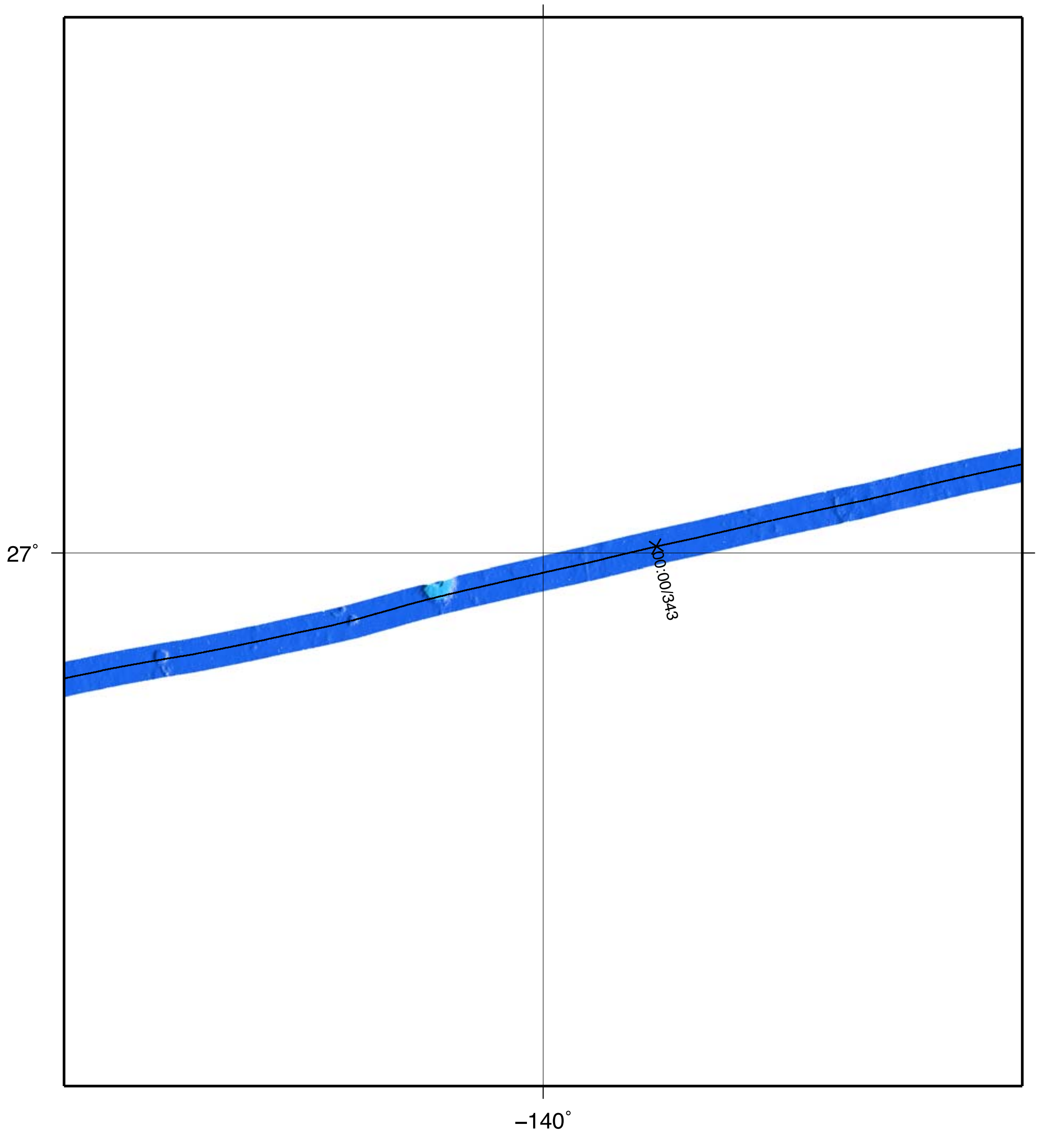

27°
26°
−142°
12:00/342
15:00/342
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000


27˚
26˚
−142˚
−50
−45
−40
−35
−30
−25
−20
−15
−10
−5
0

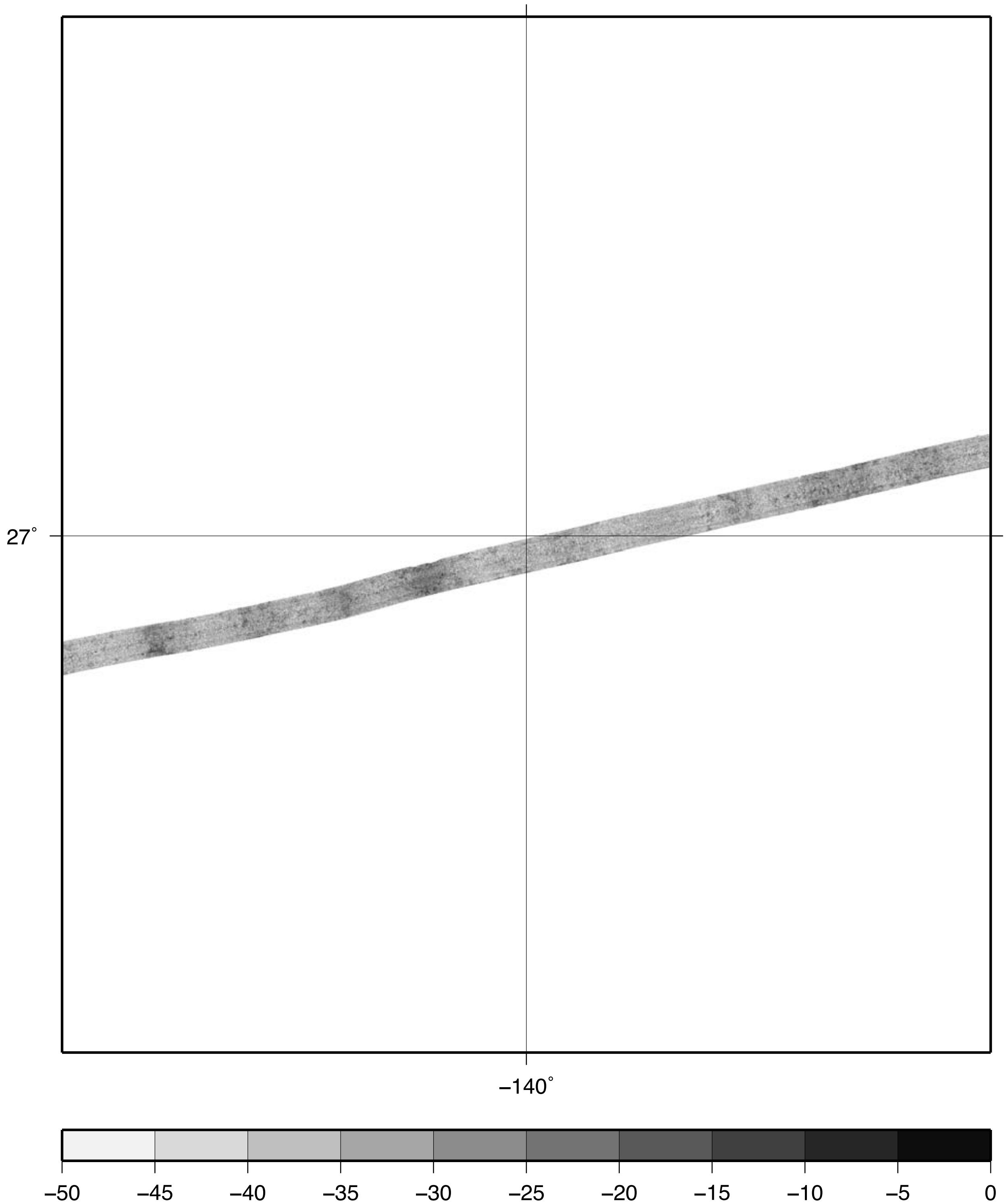


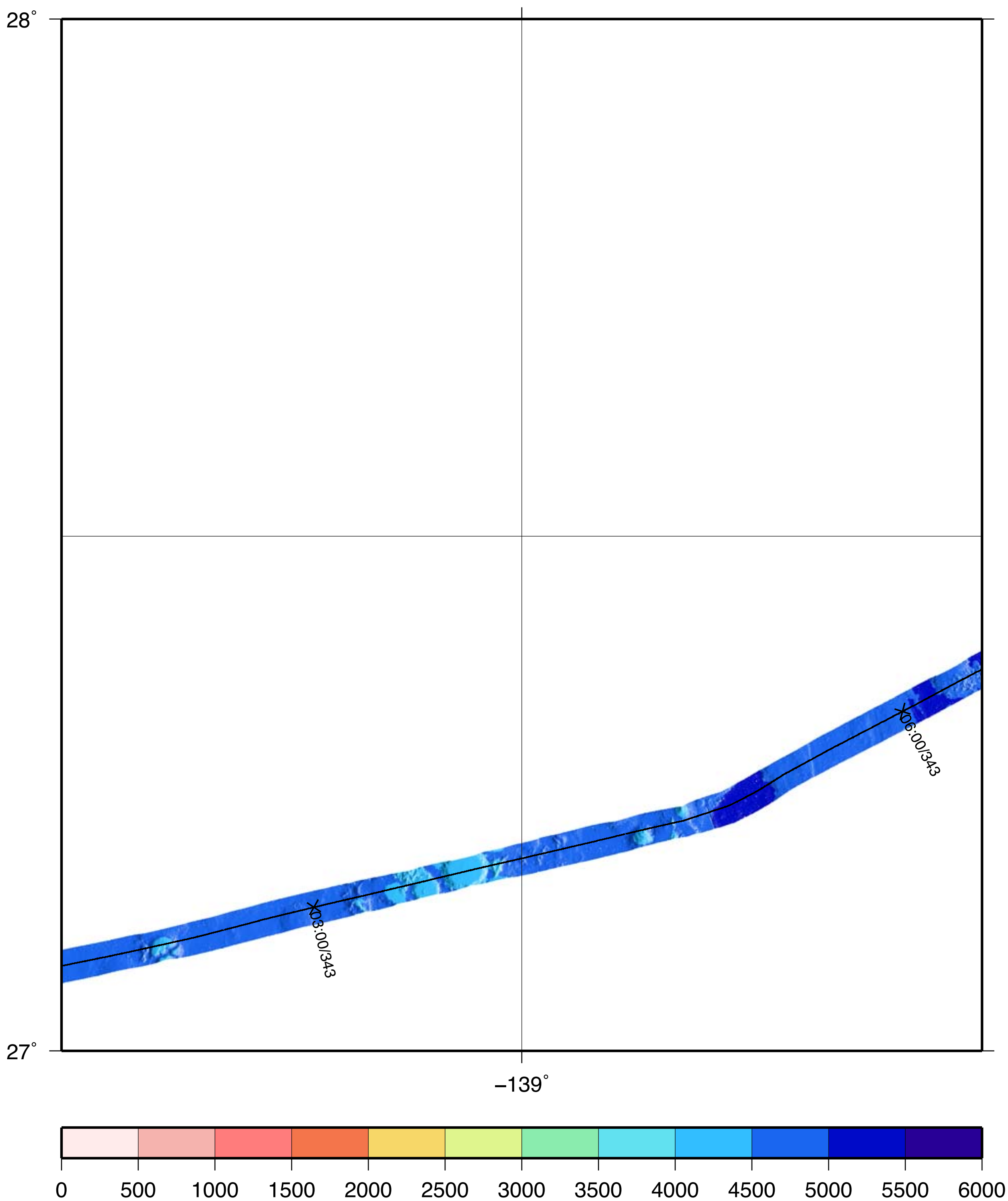
27˚
18:00/342
21:00/342
26˚
−141˚
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000


27°
26°
−141°
−50
−45
−40
−35
−30
−25
−20
−15
−10
−5
0

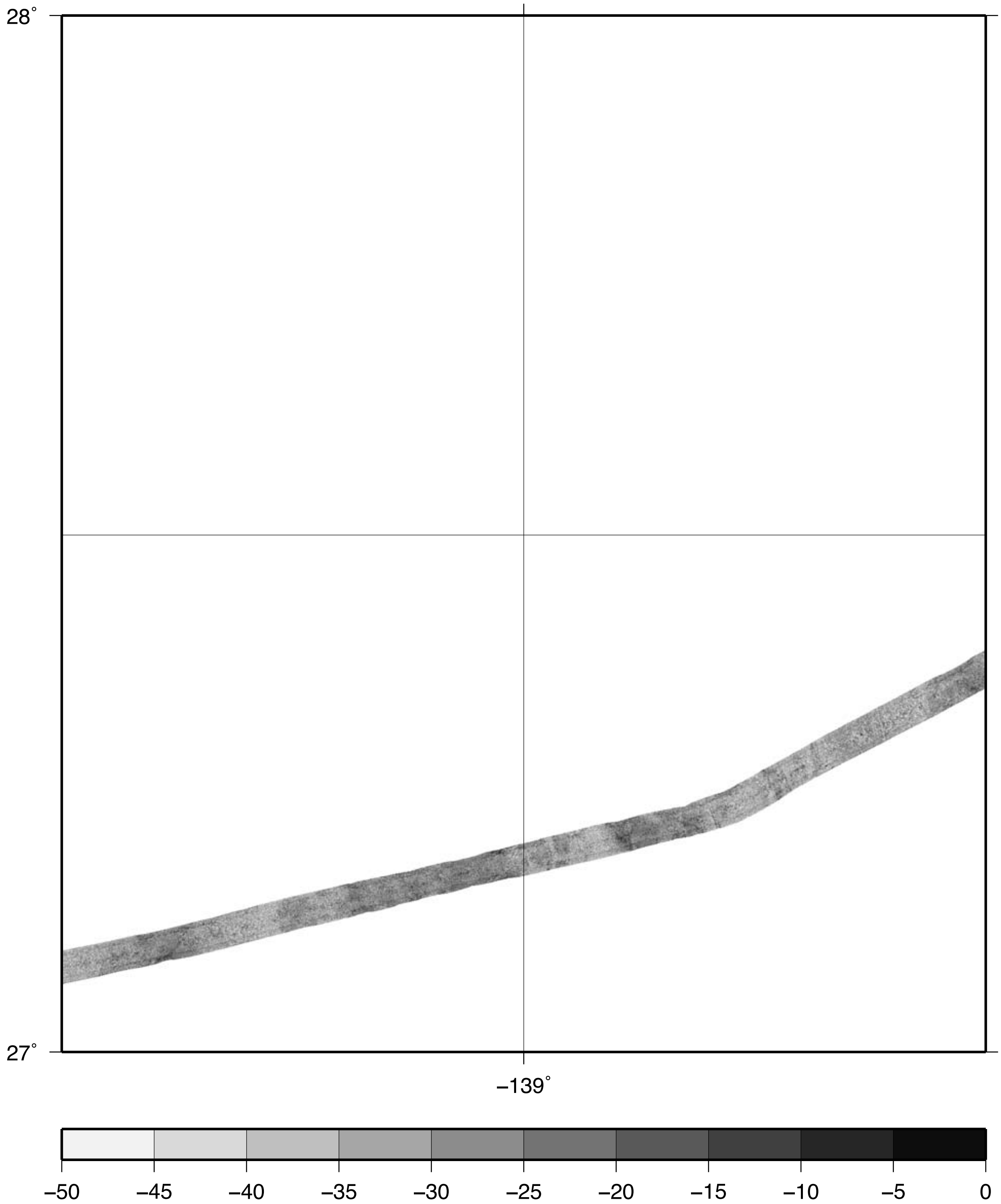


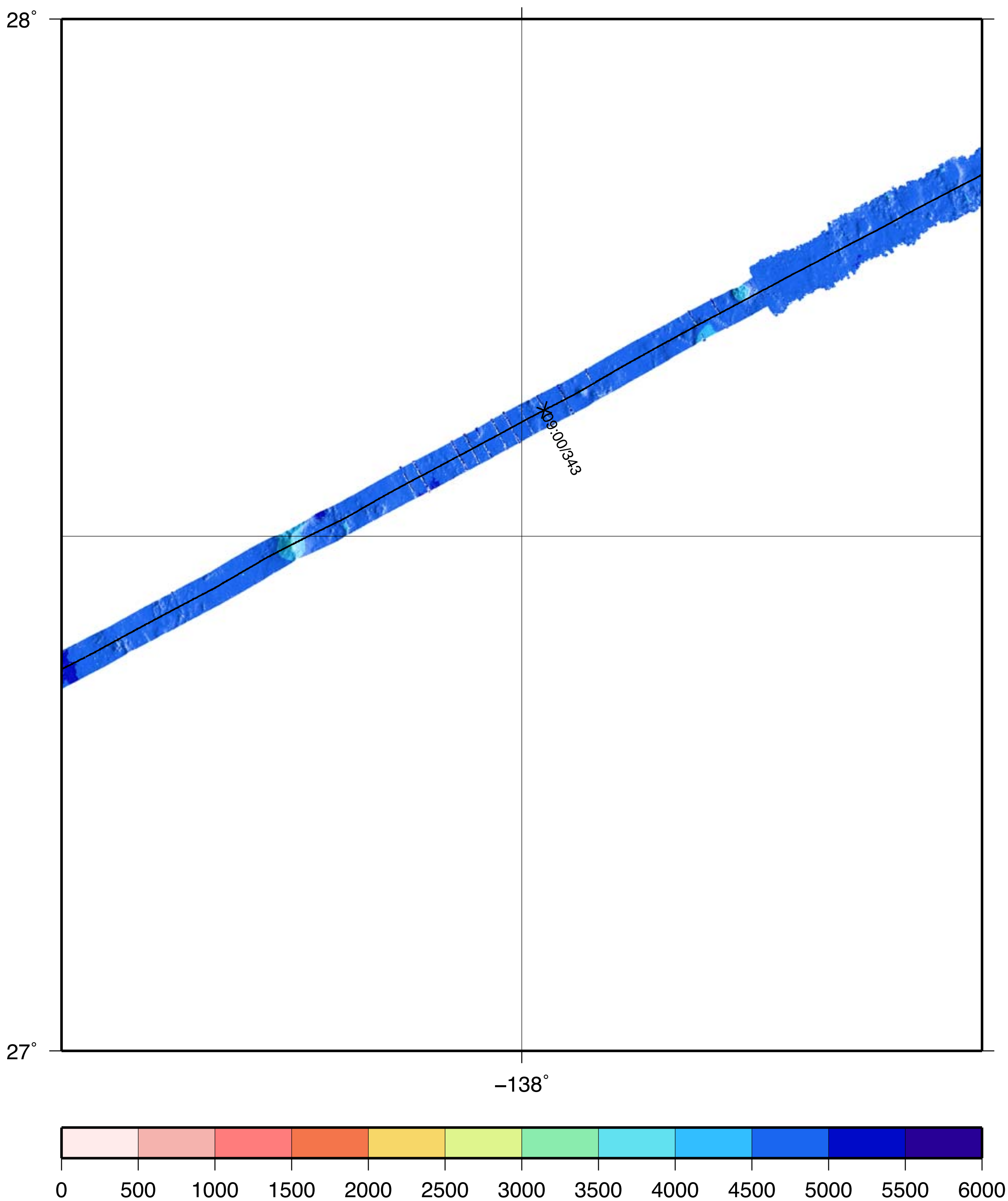
27°
00:00/343
−140°
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000


27°
−140°
−50
−45
−40
−35
−30
−25
−20
−15
−10
−5
0

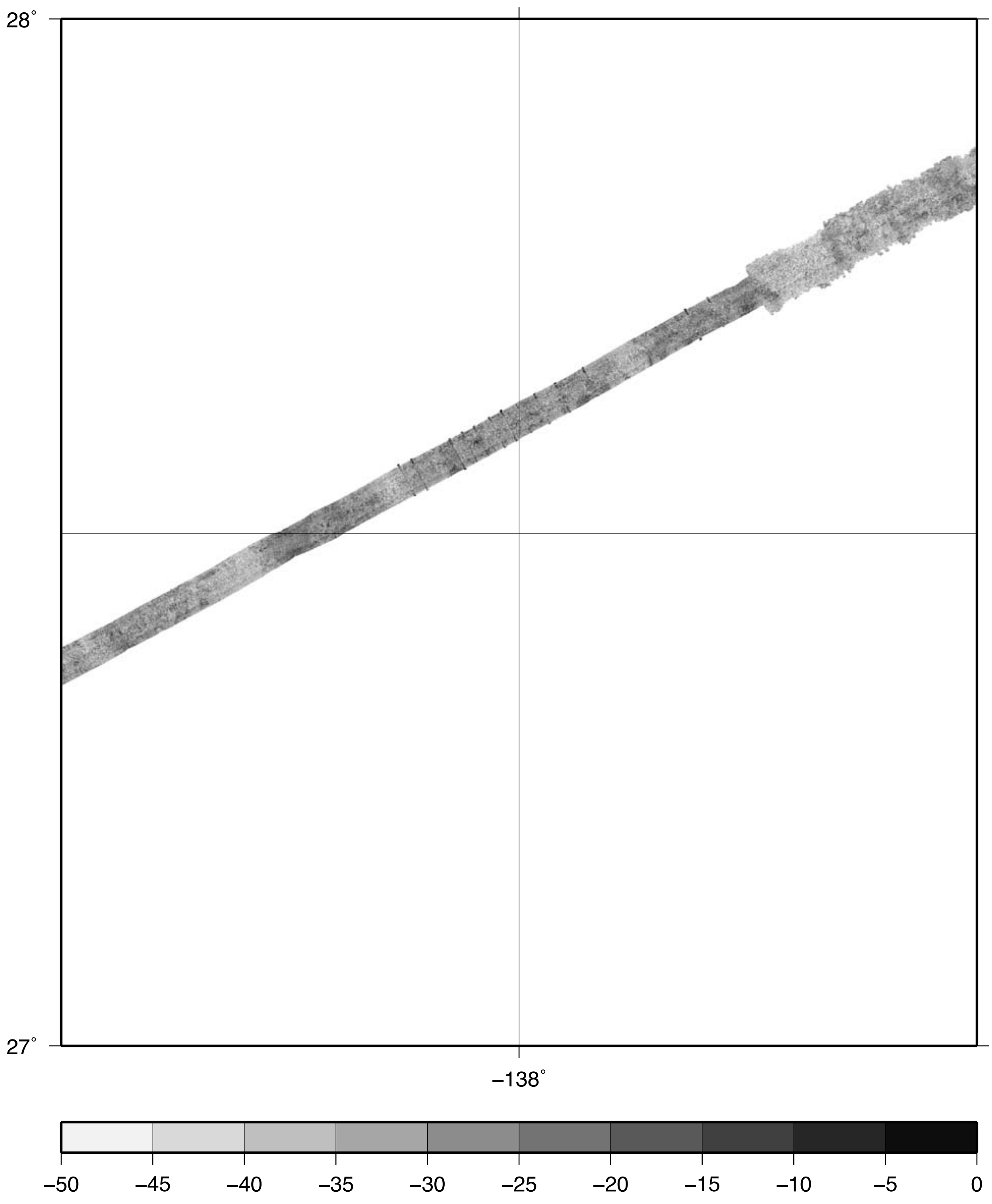


28˚
27˚
−139˚
03:00/343
06:00/343
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000

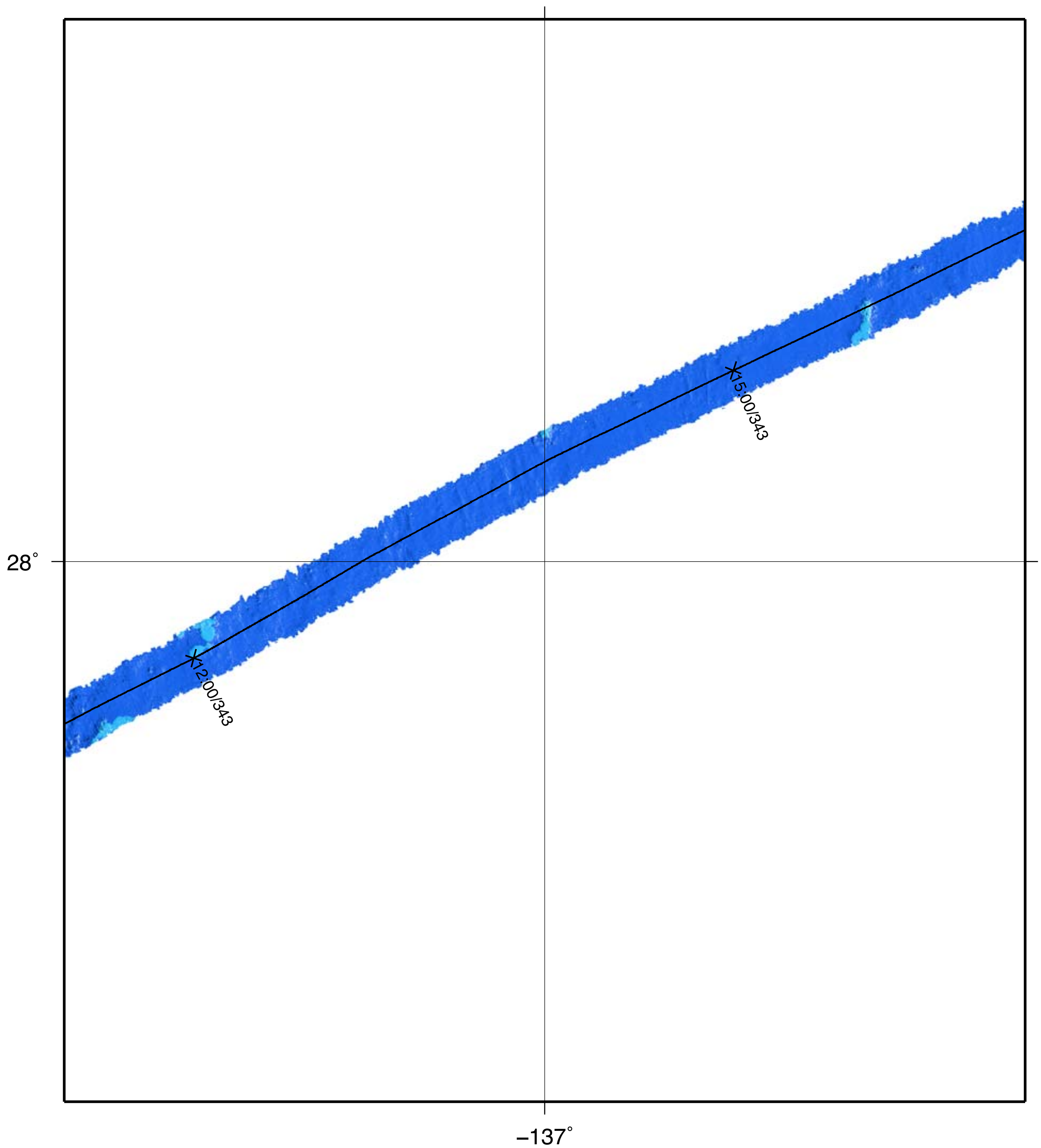

28˚
27˚
−139˚
−50 −45 −40 −35 −30 −25 −20 −15 −10 −5 0

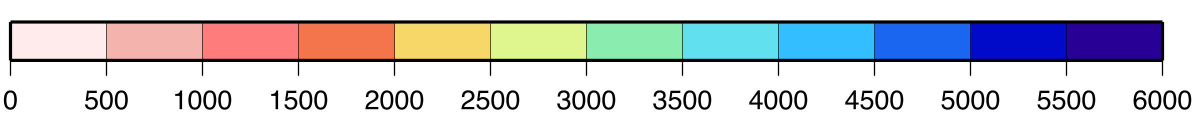


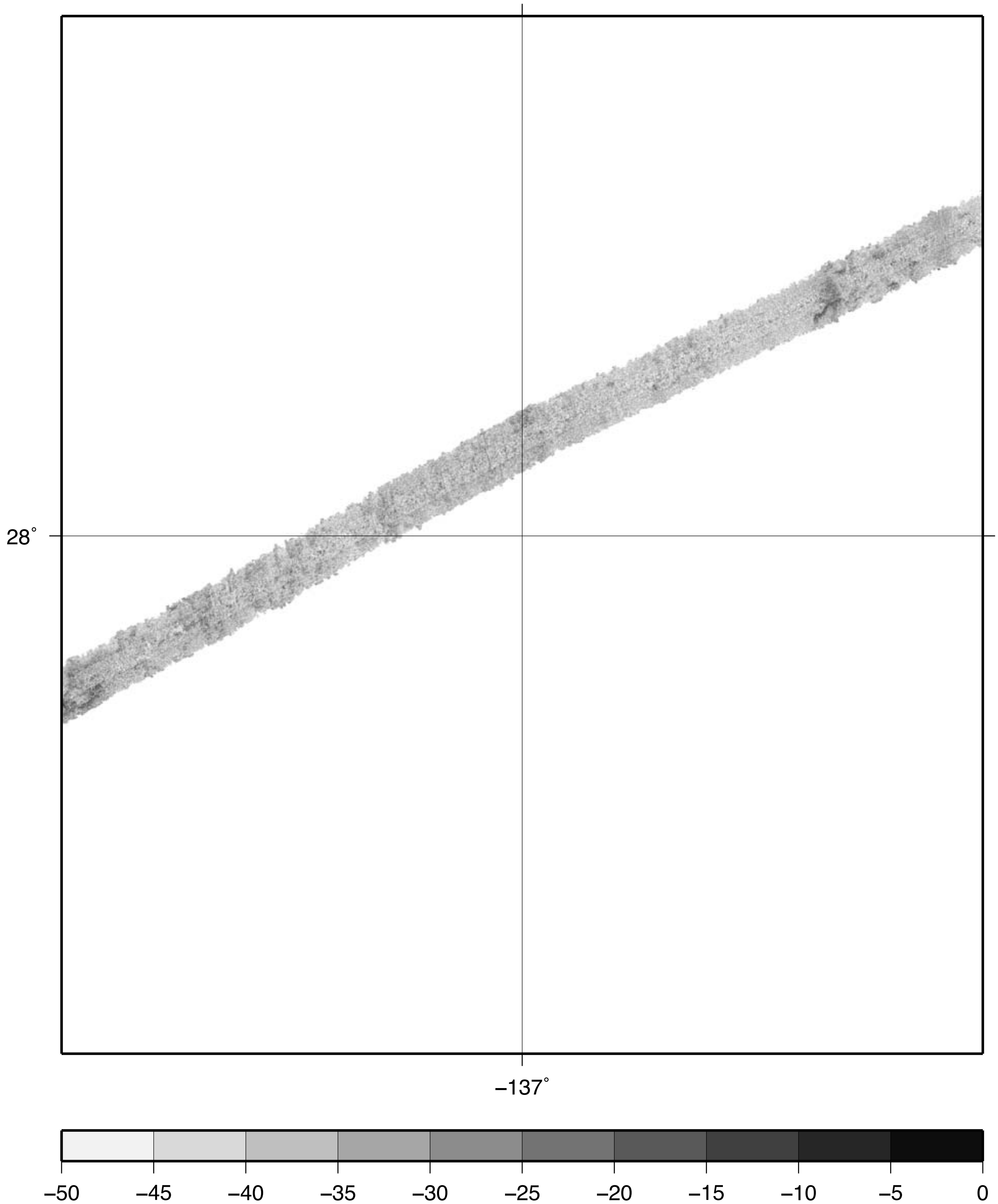
28˚
27˚
-138˚
09:00/343
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000

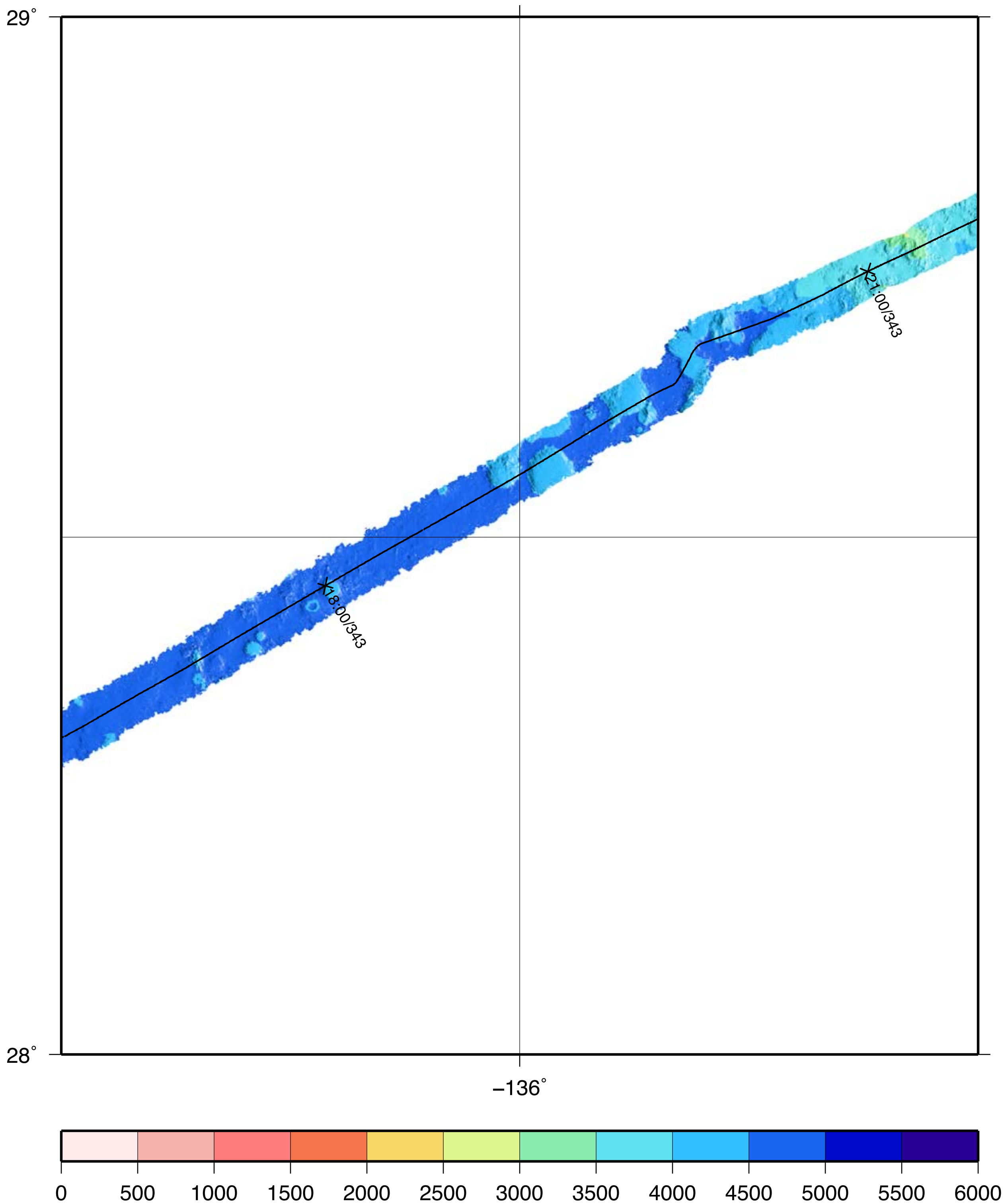


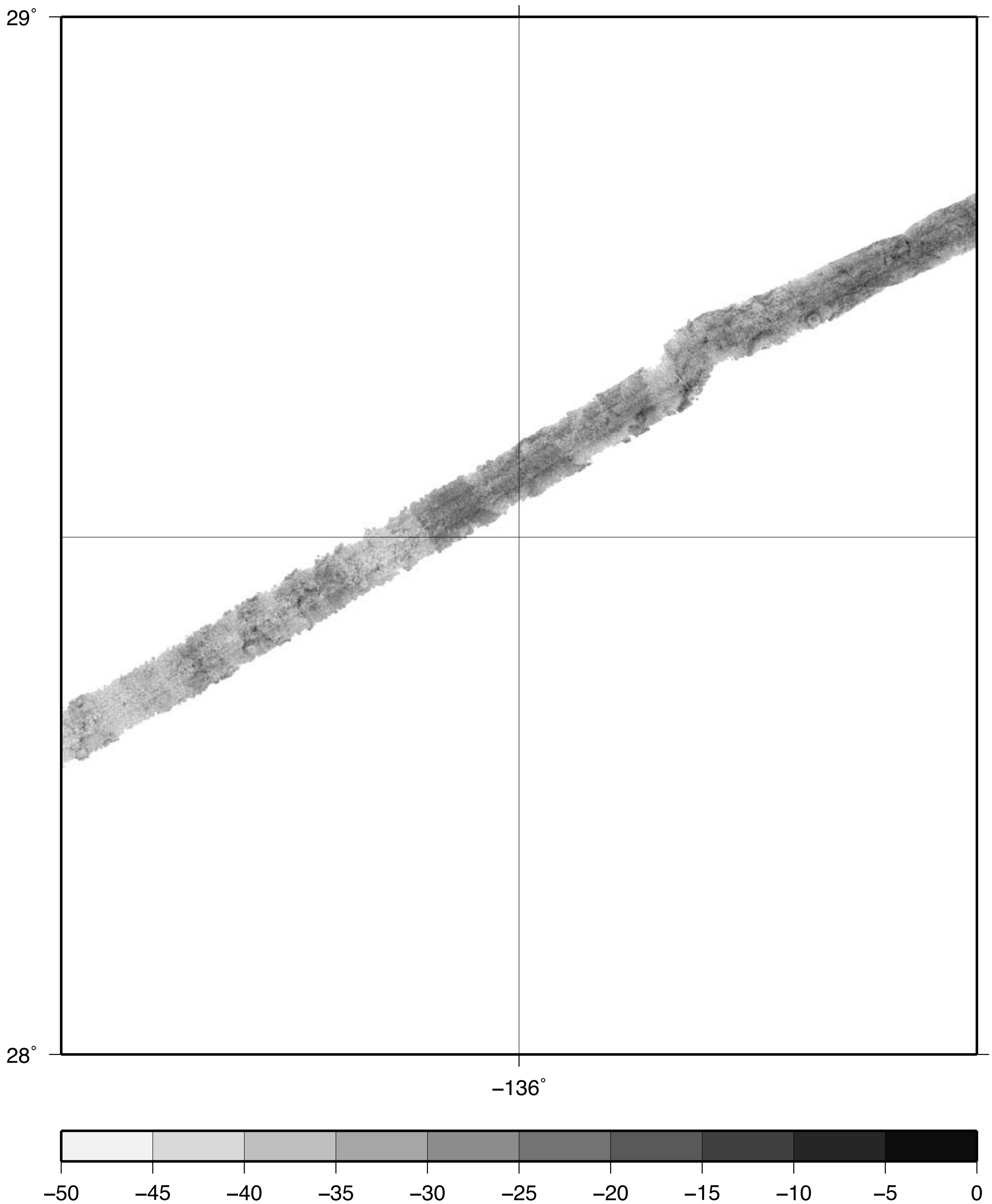
28˚
27˚
−138˚
−50
−45
−40
−35
−30
−25
−20
−15
−10
−5
0

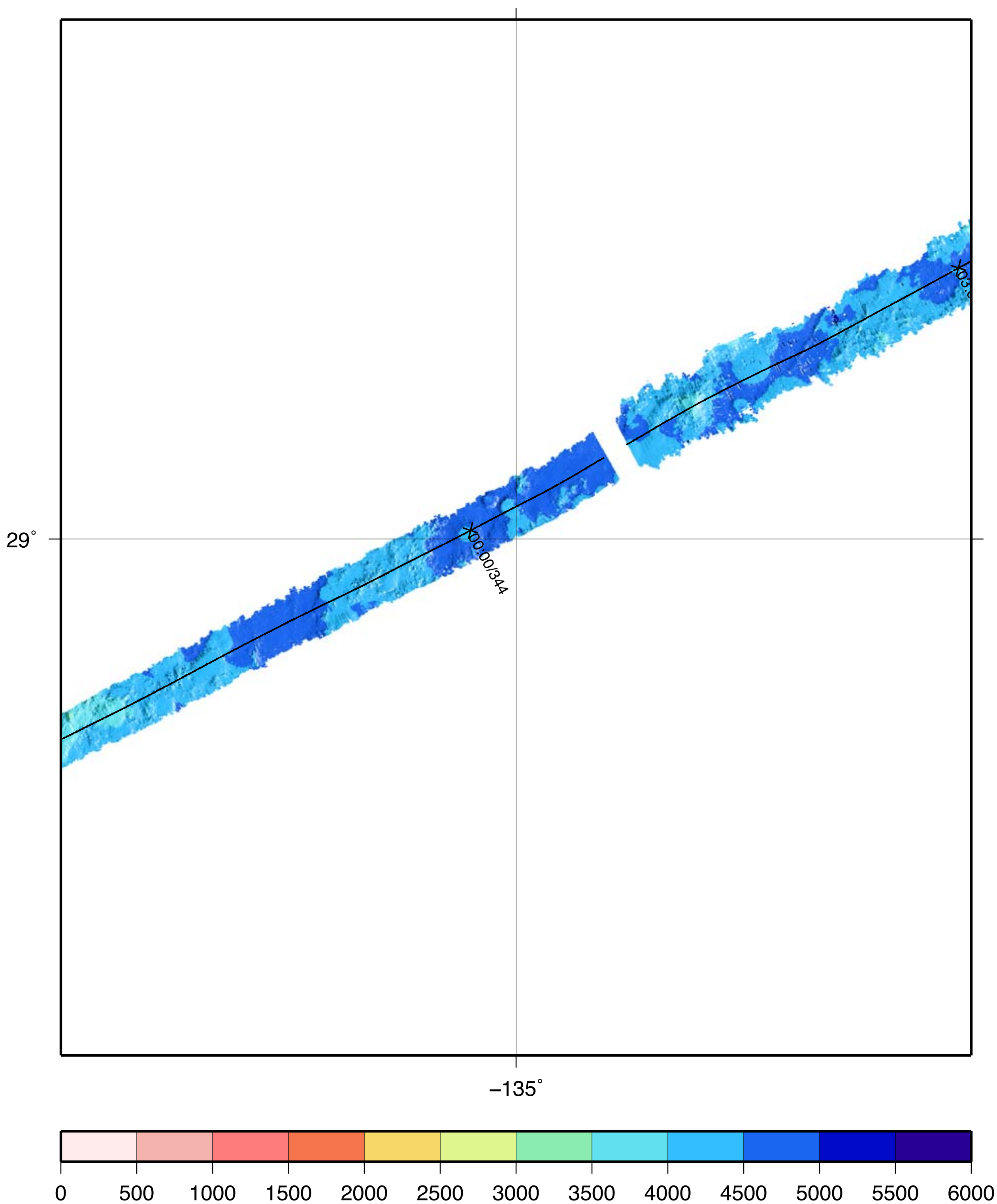

28˚
–137˚
12:00/343
15:00/343


0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000

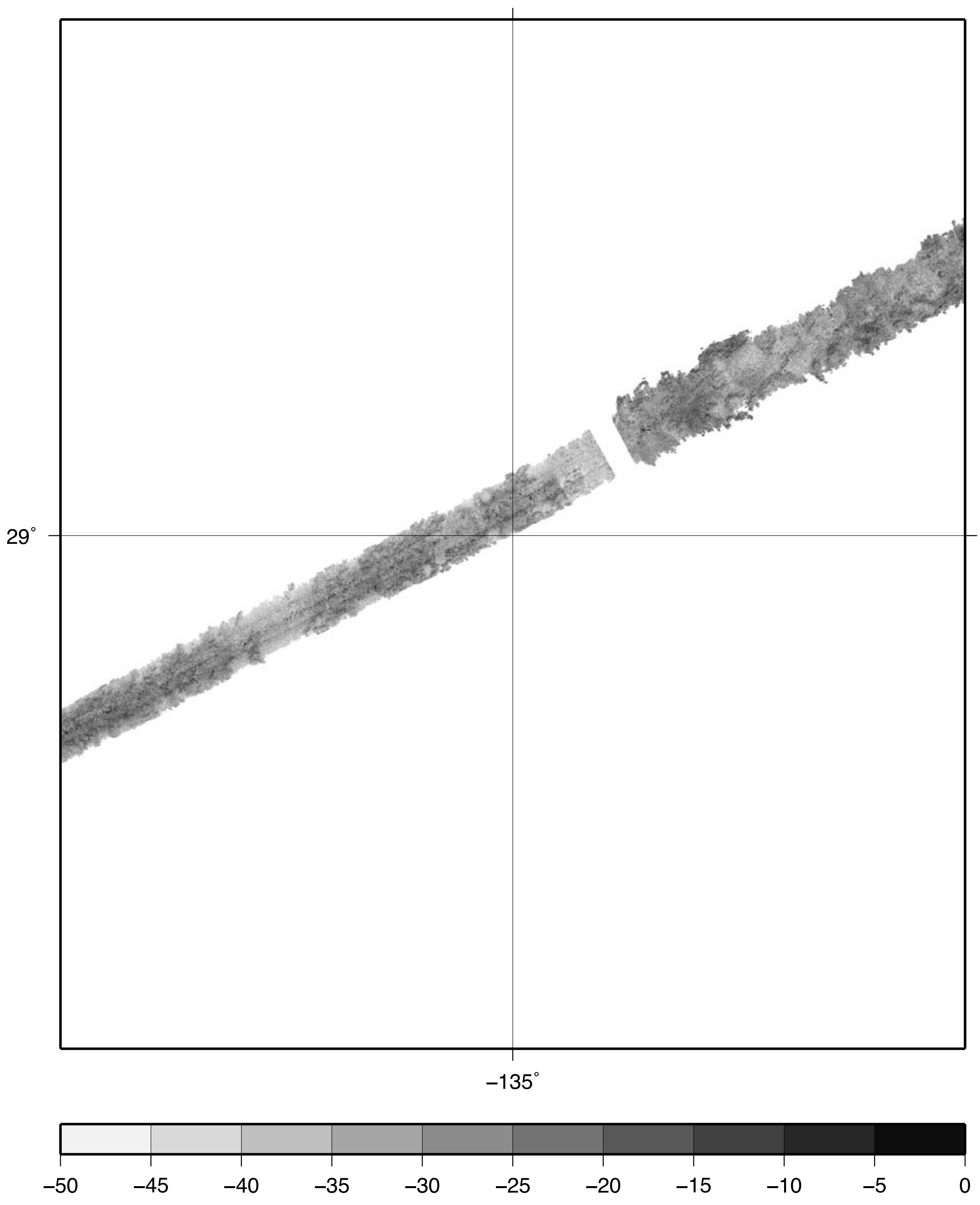

28˚
−137˚
−50
−45
−40
−35
−30
−25
−20
−15
−10
−5
0

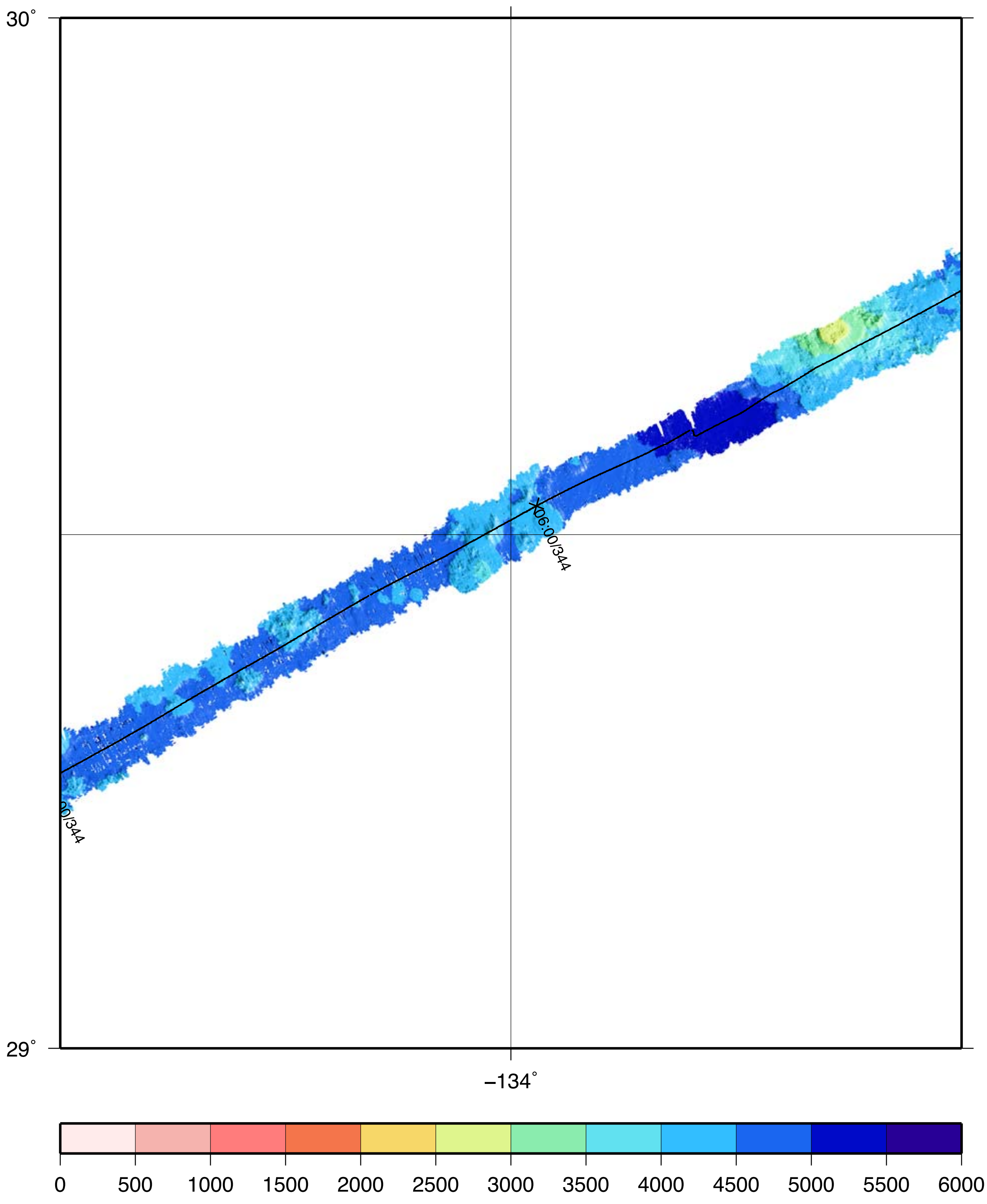

29˚
28˚
−136˚
18:00/343
21:00/343
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000

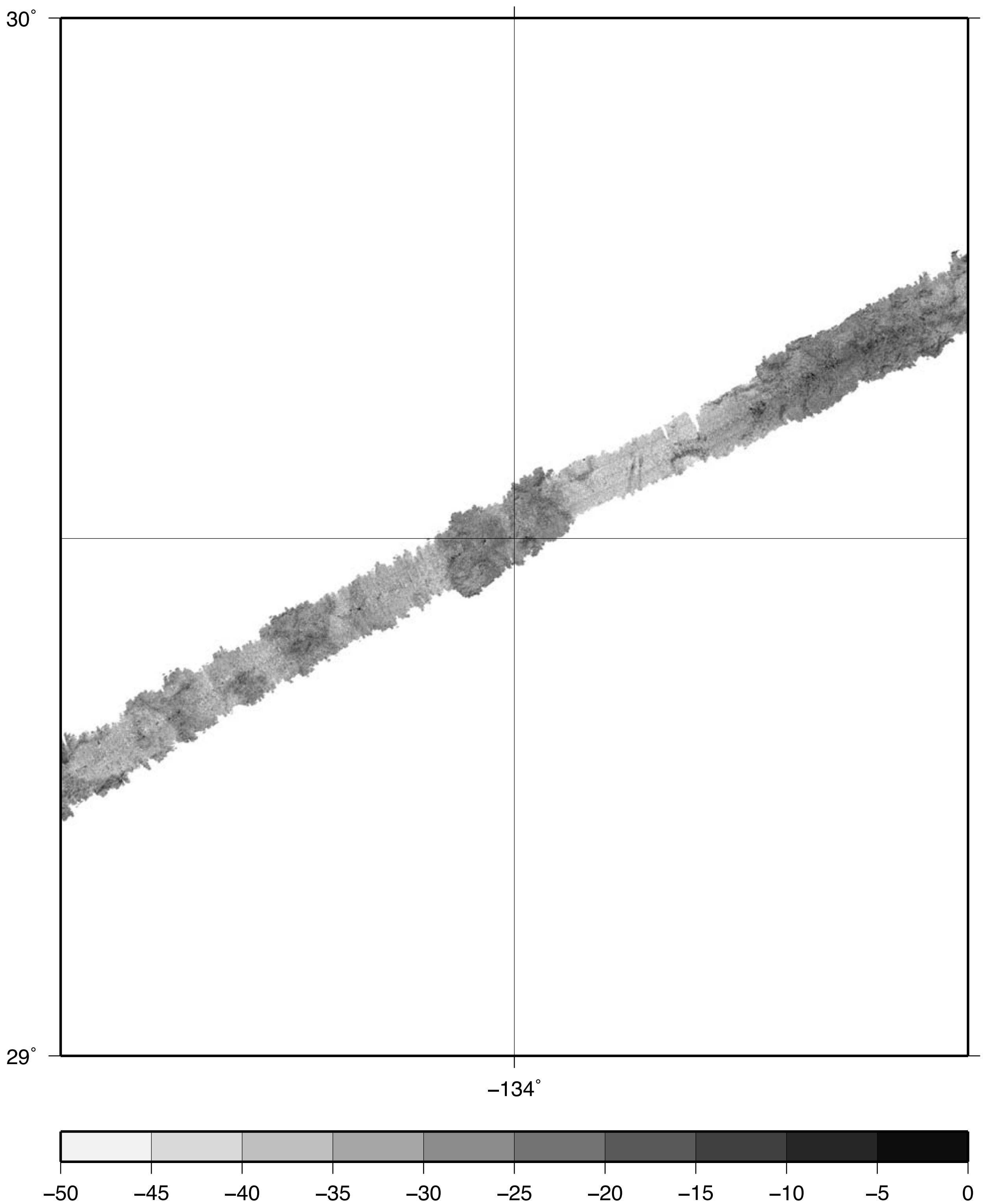

29˚
28˚
−136˚
−50
−45
−40
−35
−30
−25
−20
−15
−10
−5
0

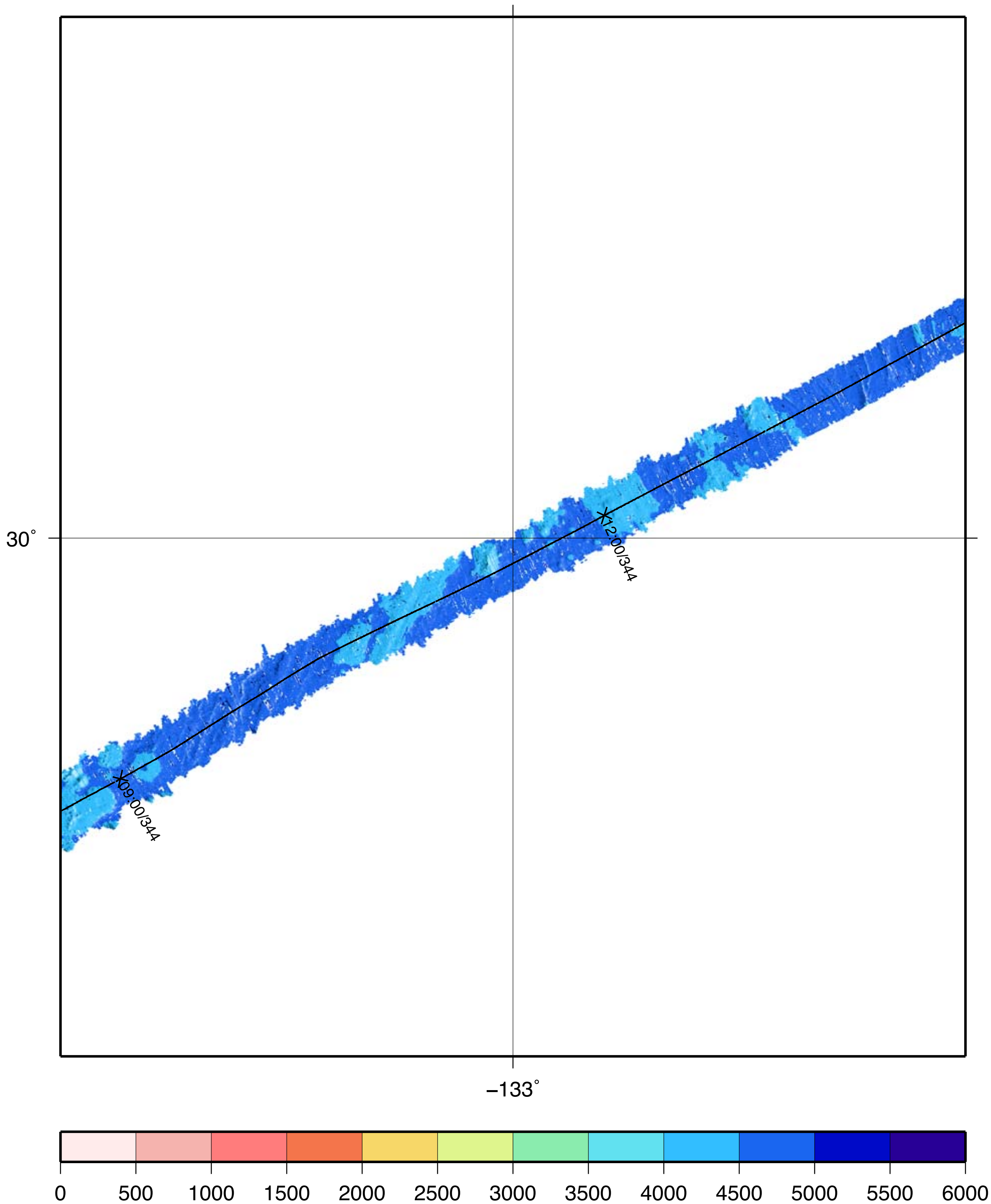


00:00/344
29˚
−135˚
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000

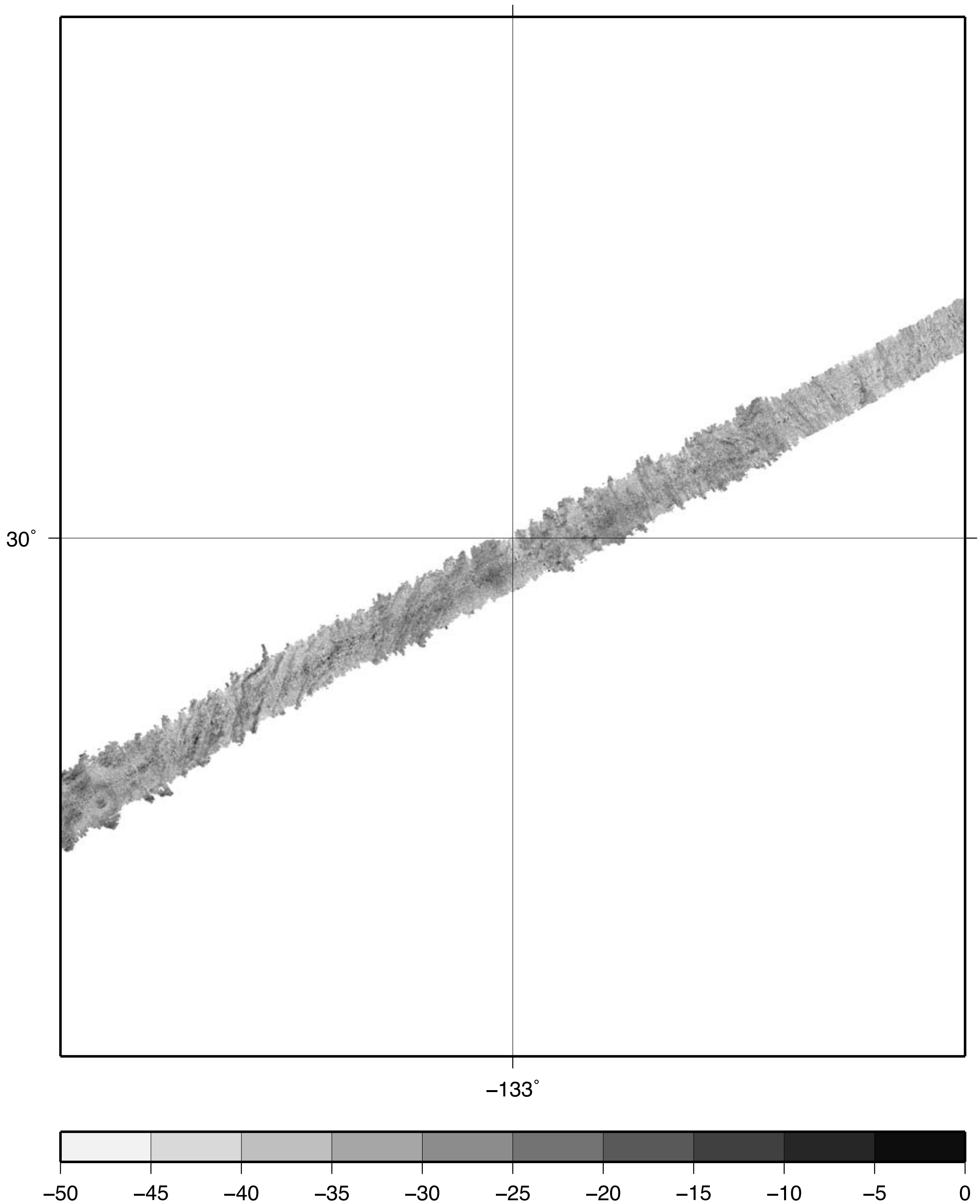

29˚
−135˚
−50
−45
−40
−35
−30
−25
−20
−15
−10
−5
0

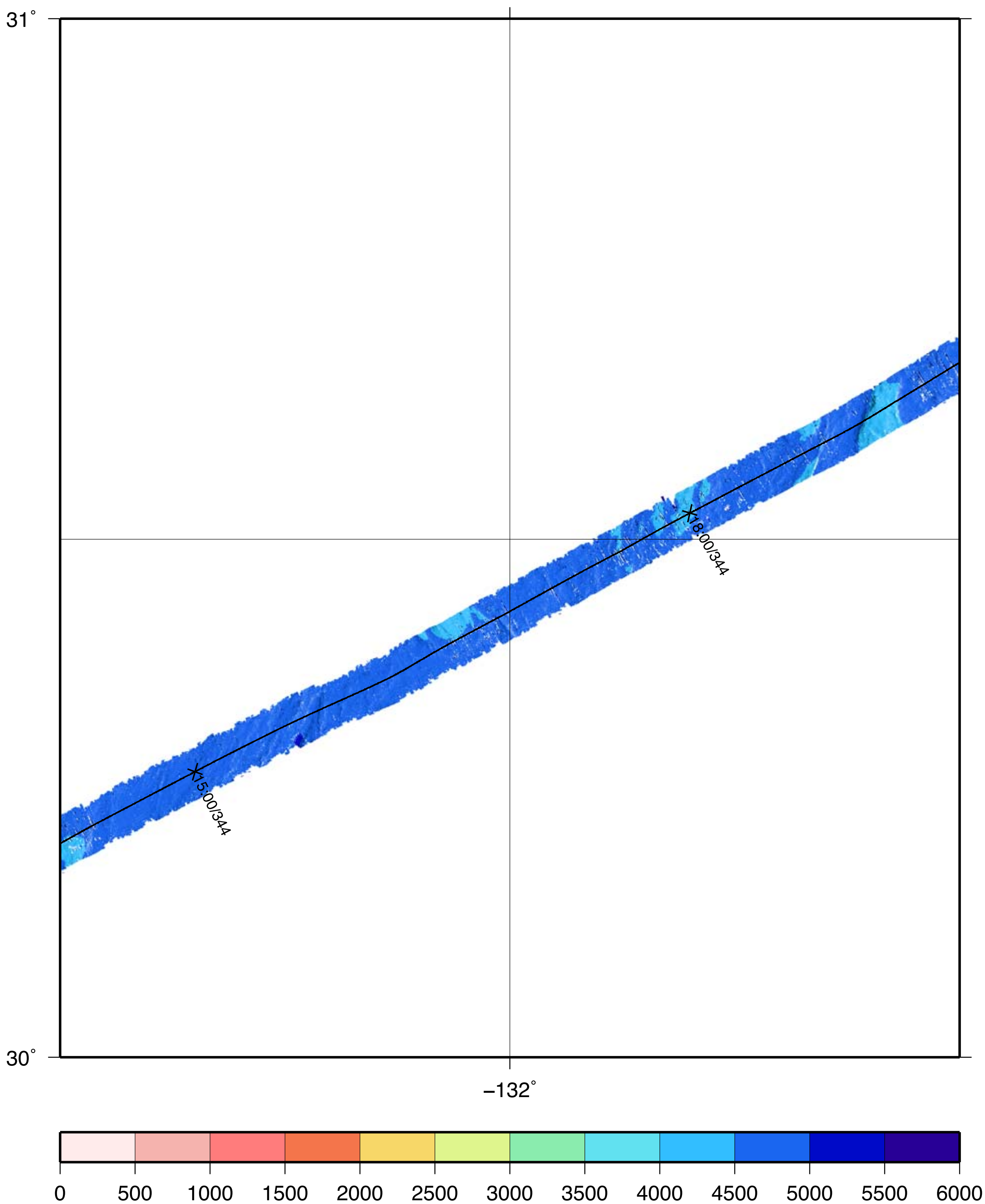

30˚
29˚
–134˚
06:00/344
00/344
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000


30˚
29˚
−134˚
−50
−45
−40
−35
−30
−25
−20
−15
−10
−5
0

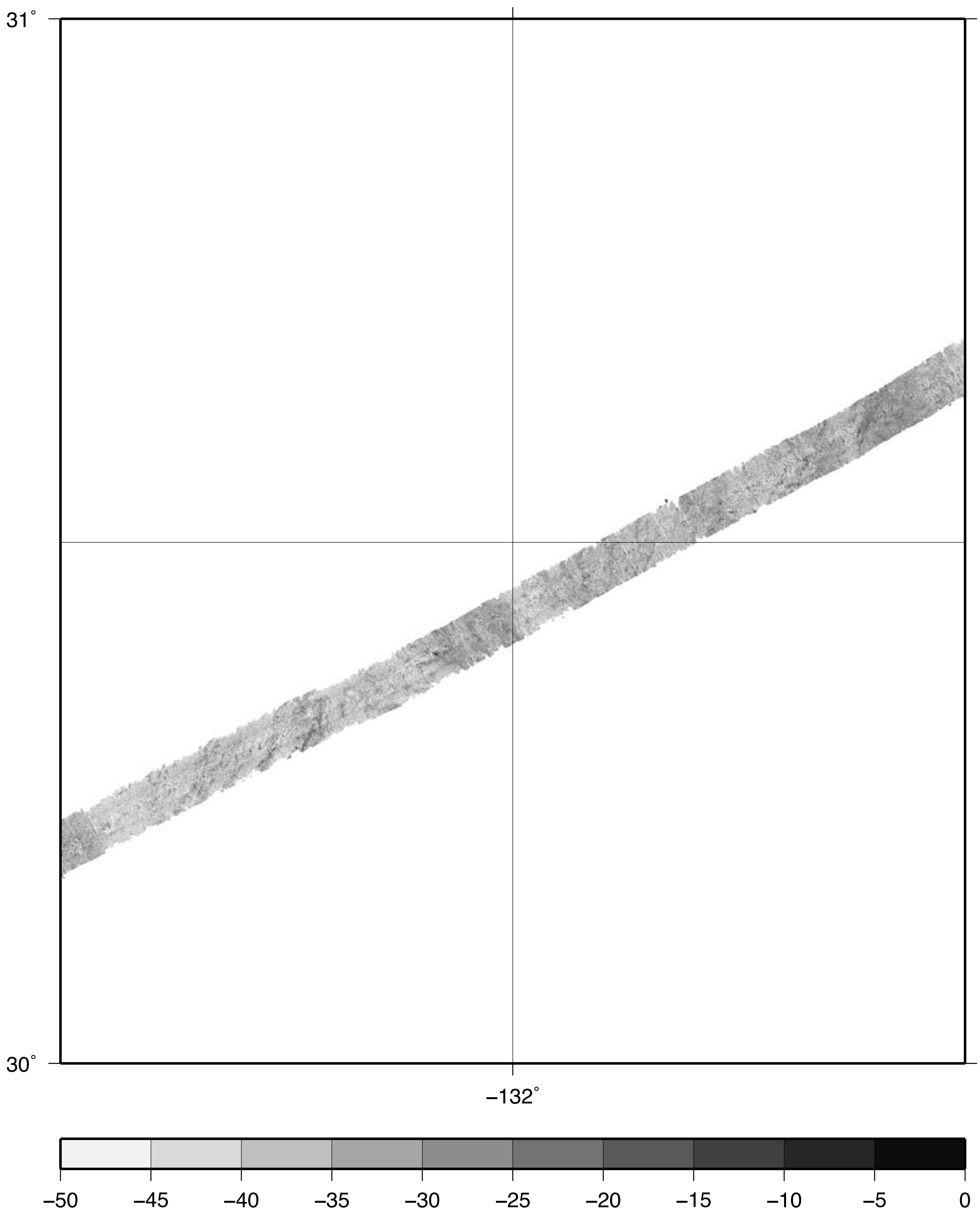


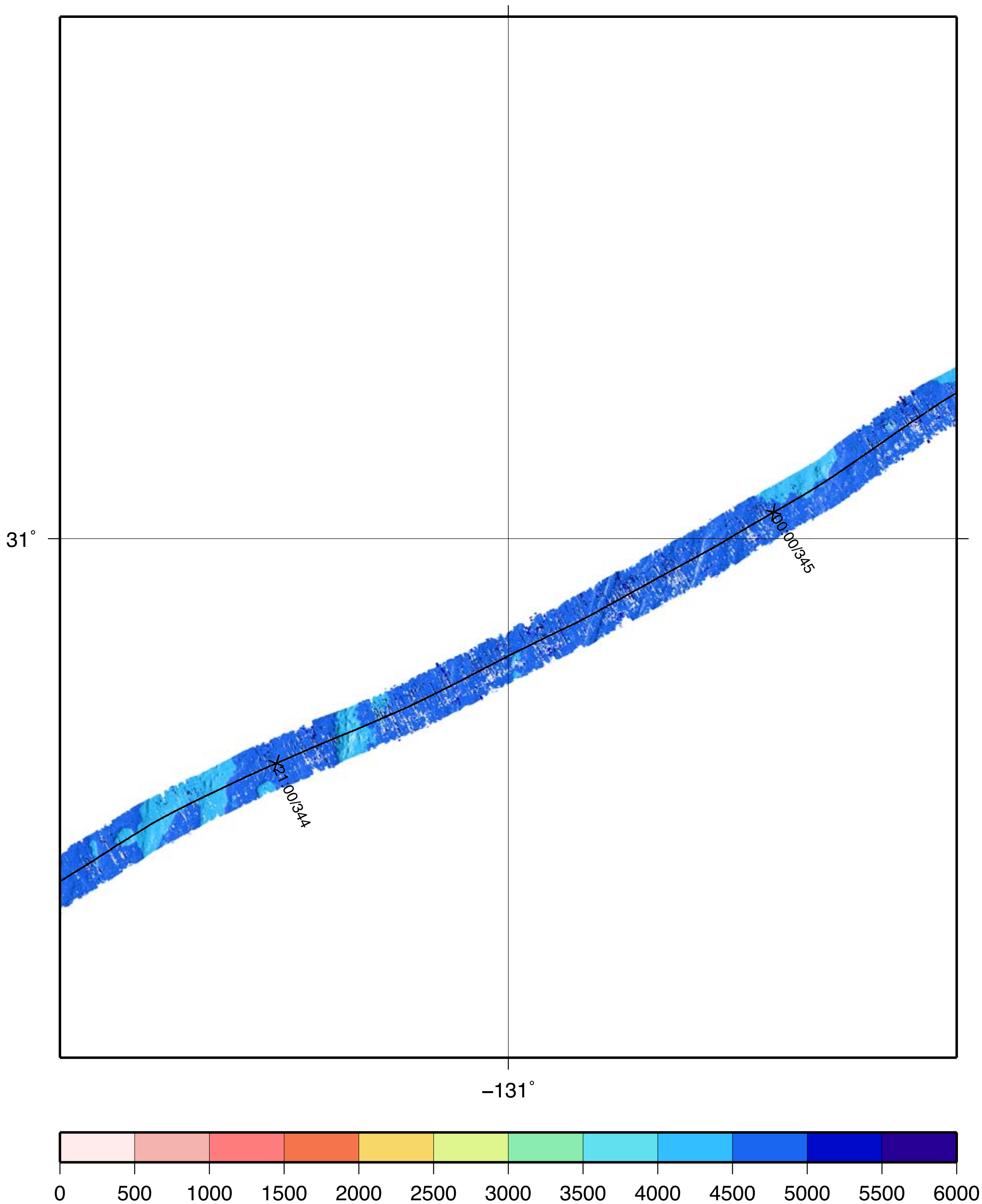
30˚
12:00/344
09:00/344
−133˚
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000


30˚
–133˚
–50
–45
–40
–35
–30
–25
–20
–15
–10
–5
0

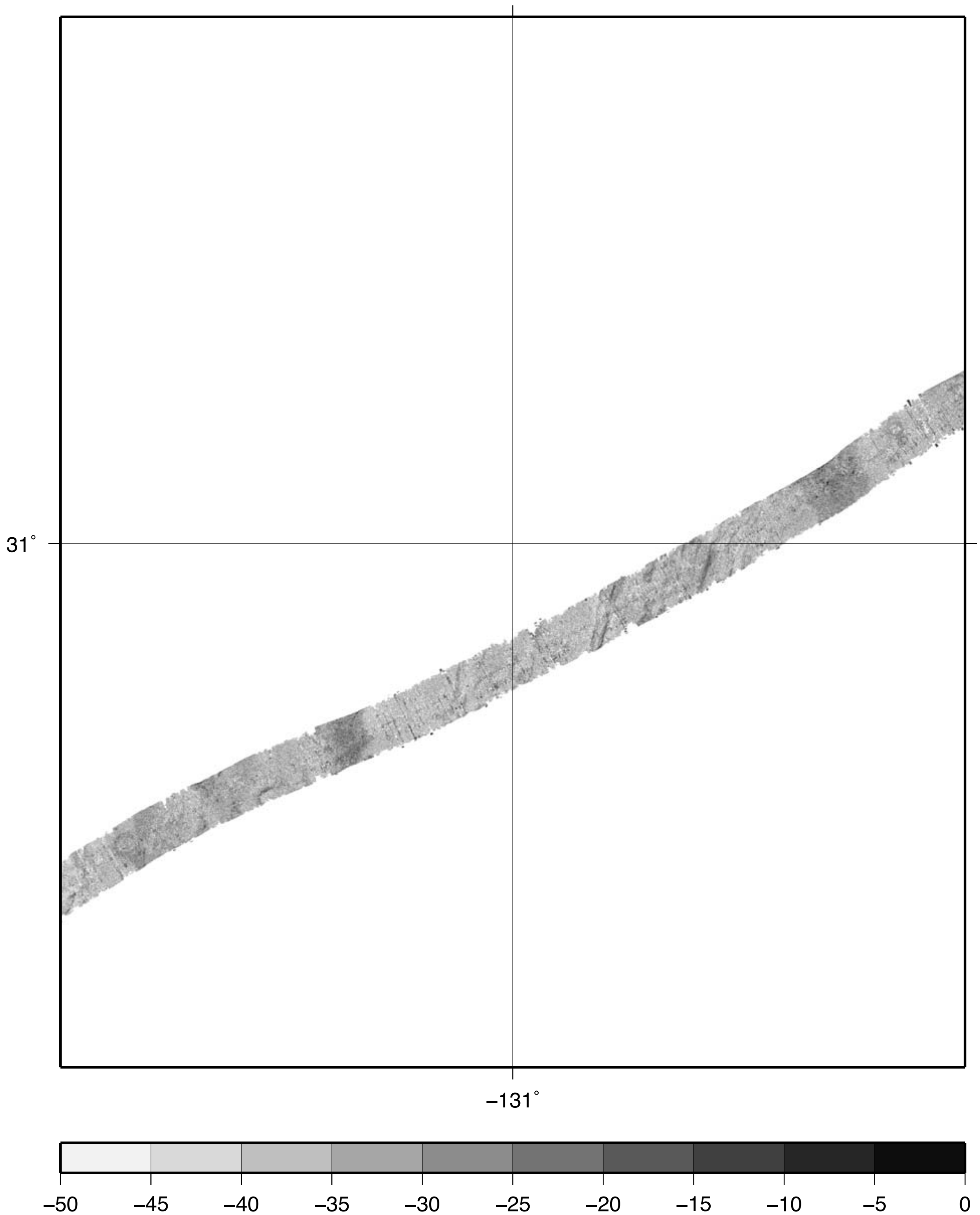


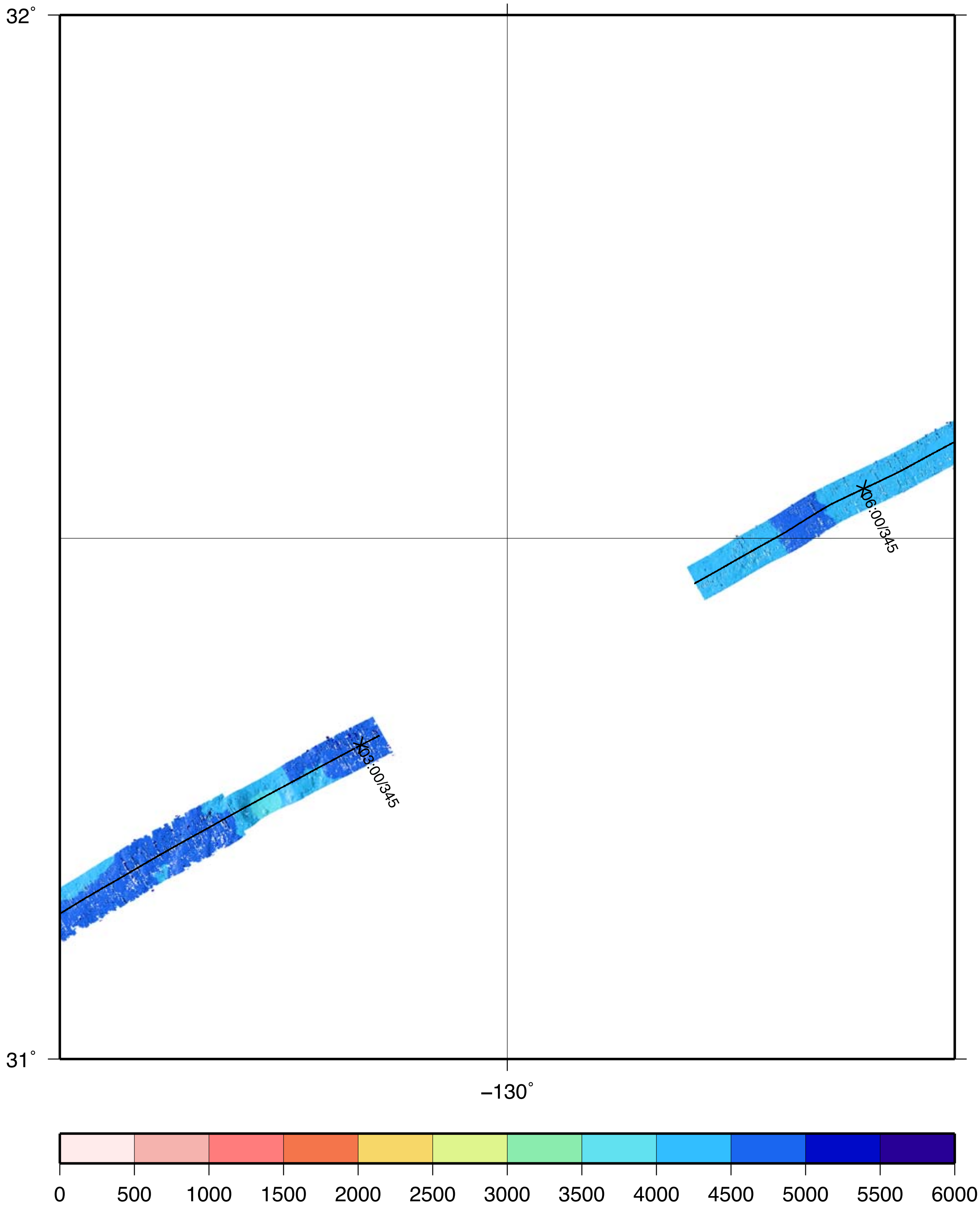
31°
30°
-132°
15:00/344
18:00/344
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000

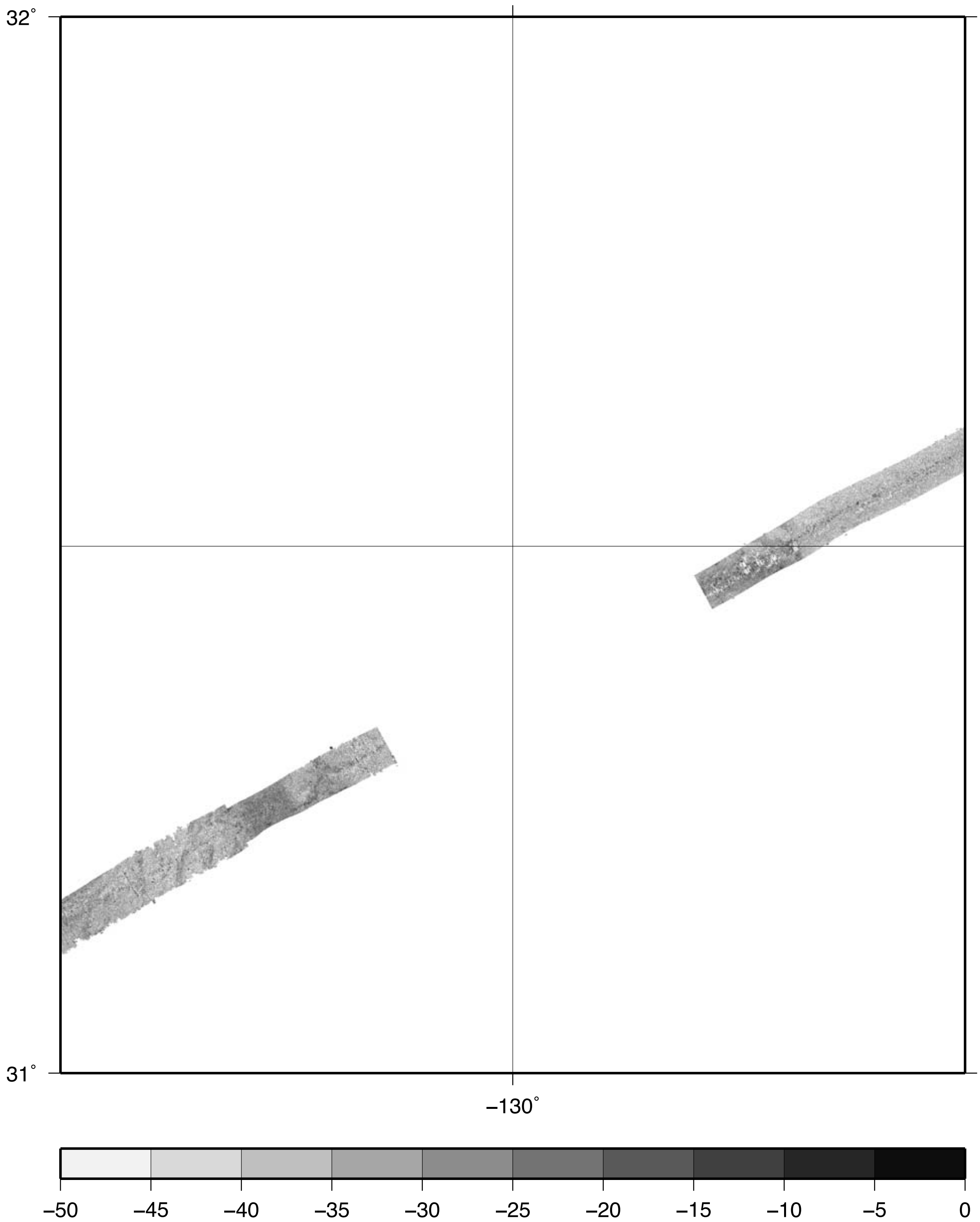

31°
30°
−132°
−50
−45
−40
−35
−30
−25
−20
−15
−10
−5
0

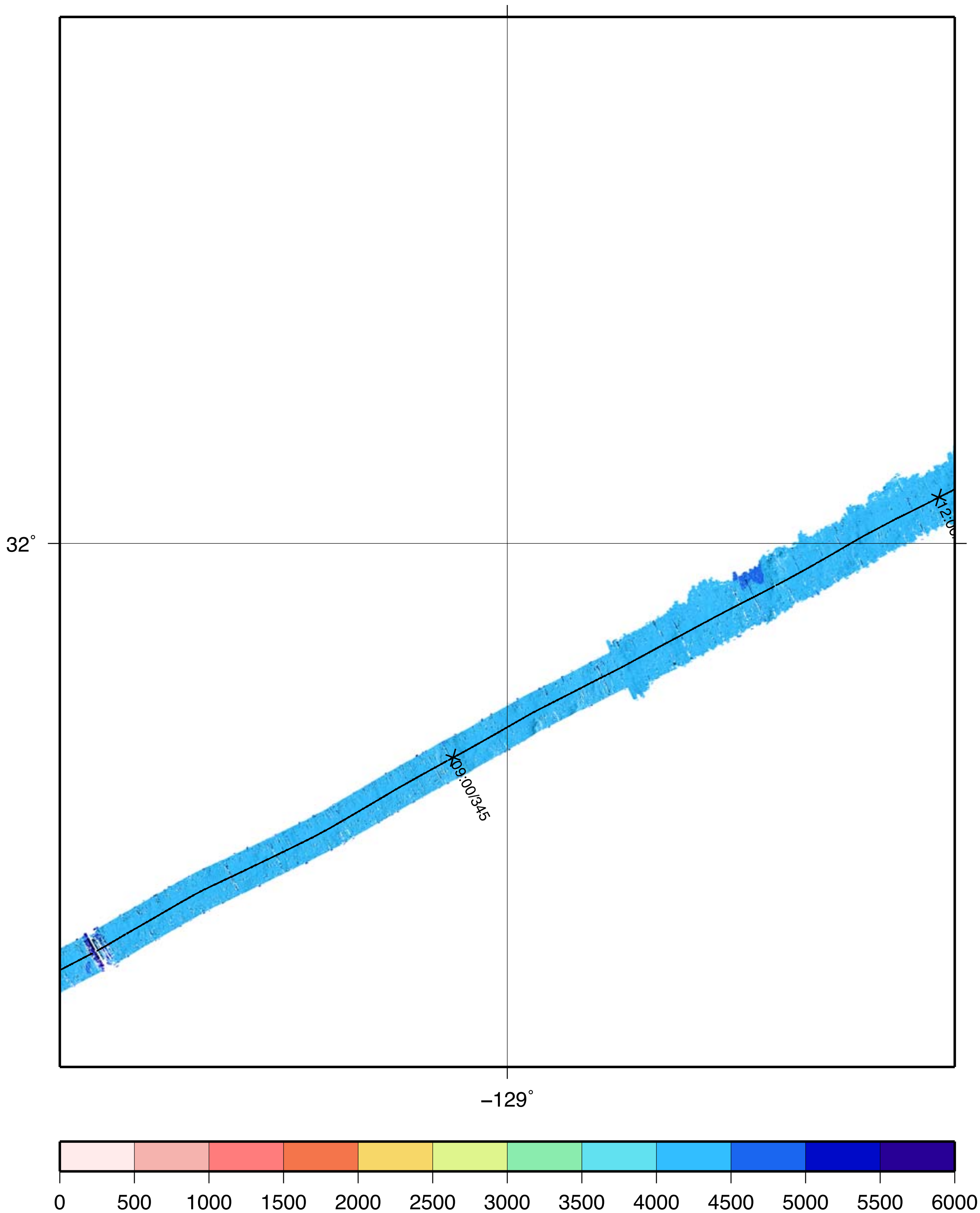


31˚
–131˚
21:00/344
00:00/345
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000

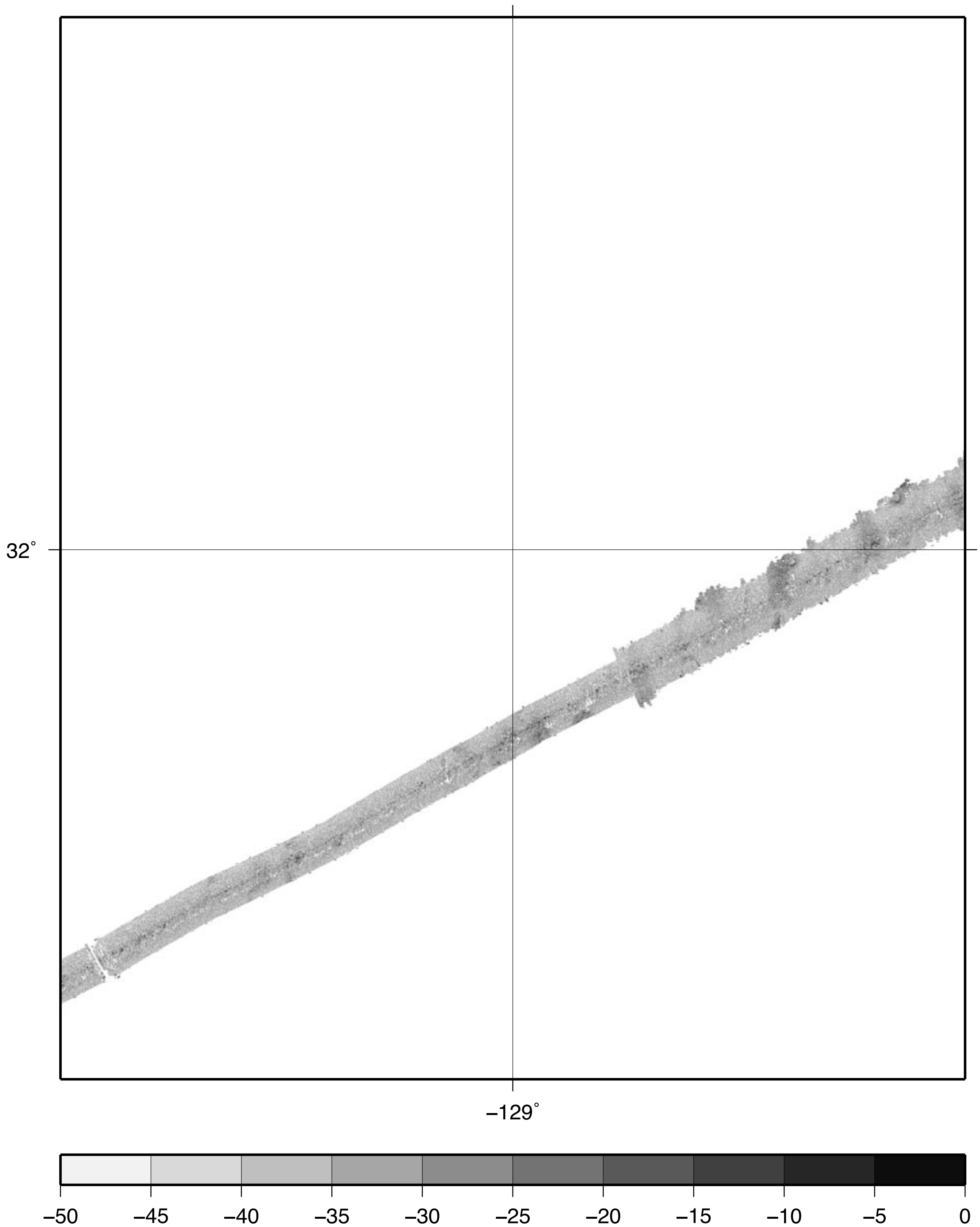

31°
−131°
−50
−45
−40
−35
−30
−25
−20
−15
−10
−5
0

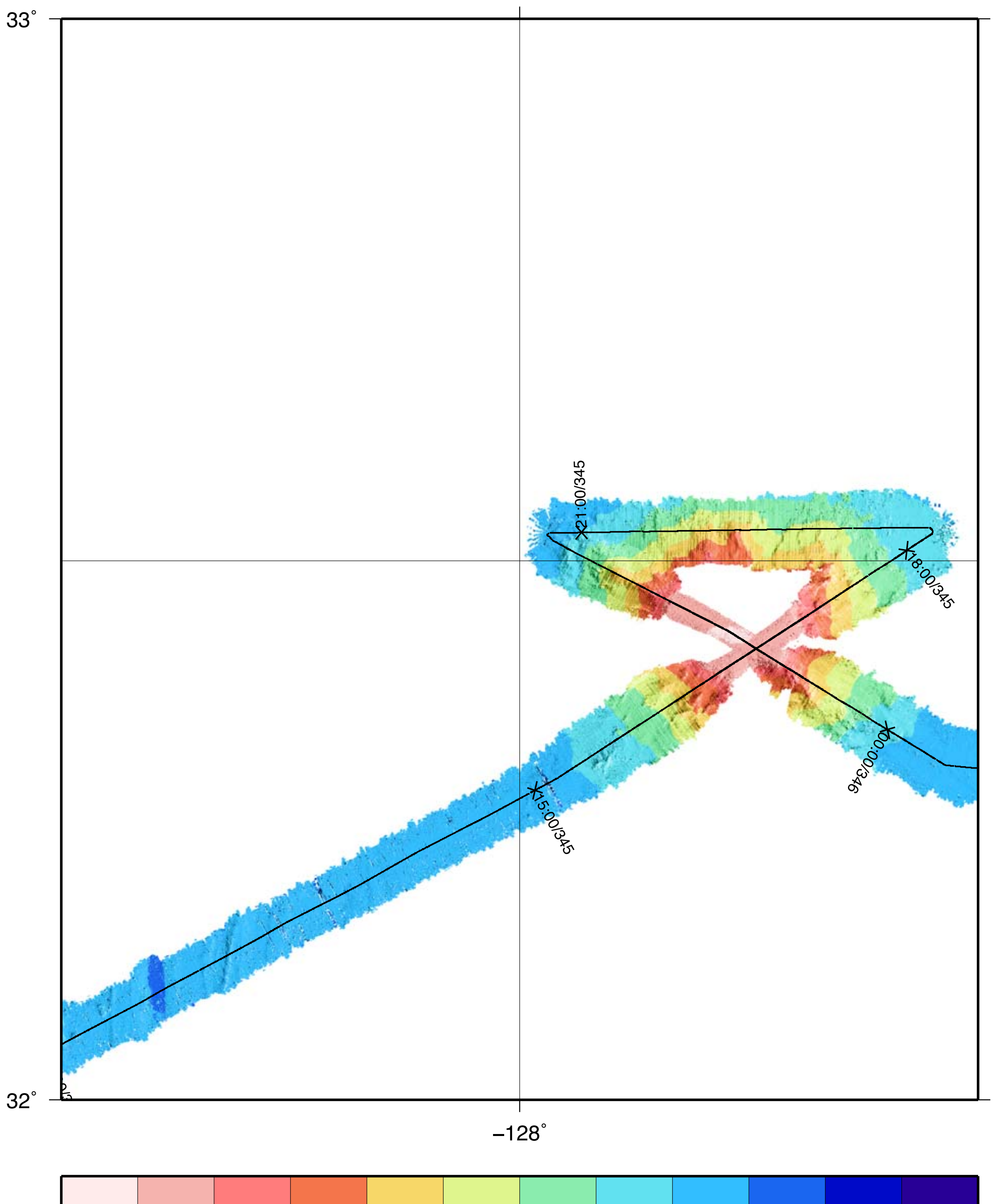

32˚
31˚
−130˚
06:00/345
03:00/345
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000

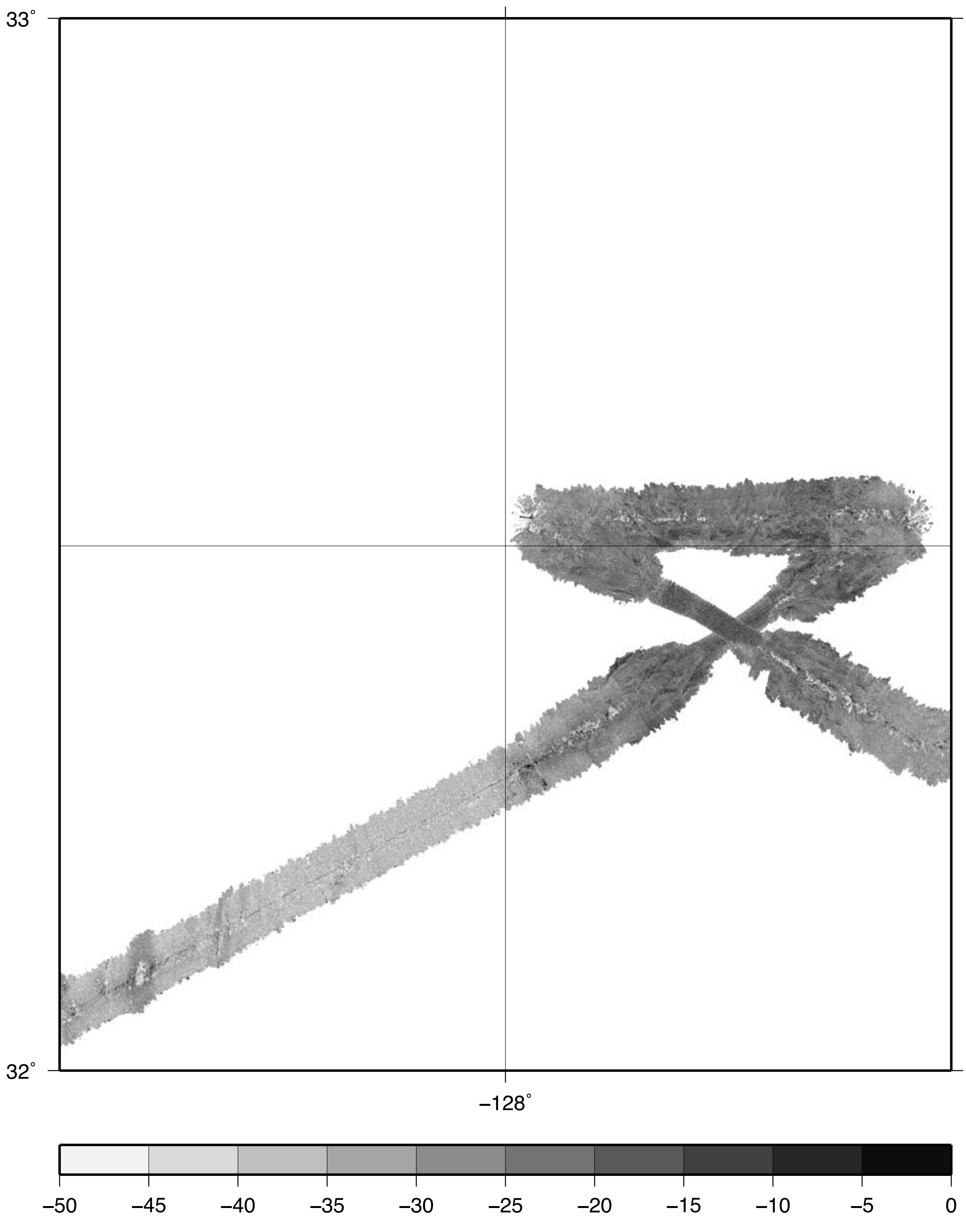

32˚
31˚
−130˚
−50
−45
−40
−35
−30
−25
−20
−15
−10
−5
0

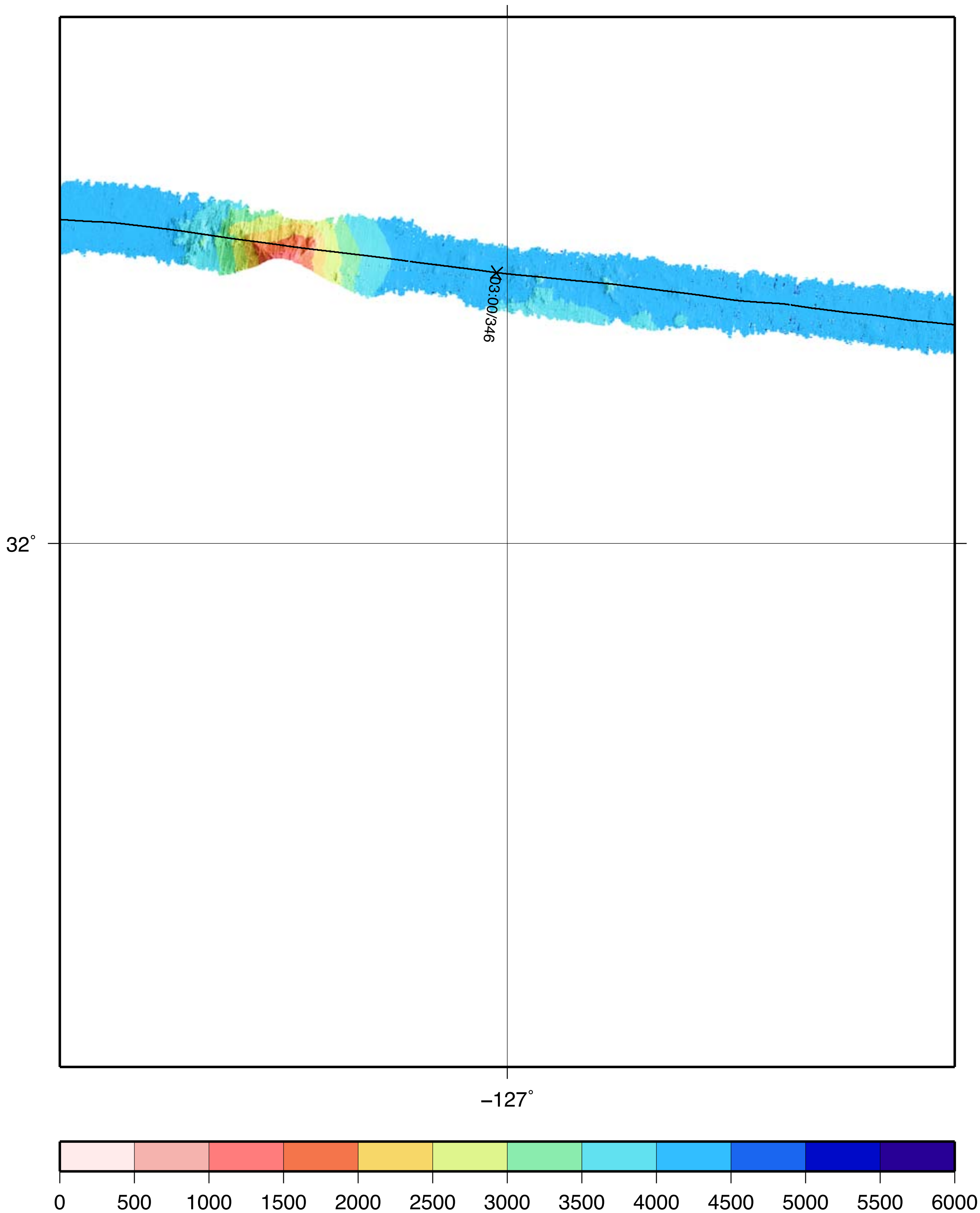


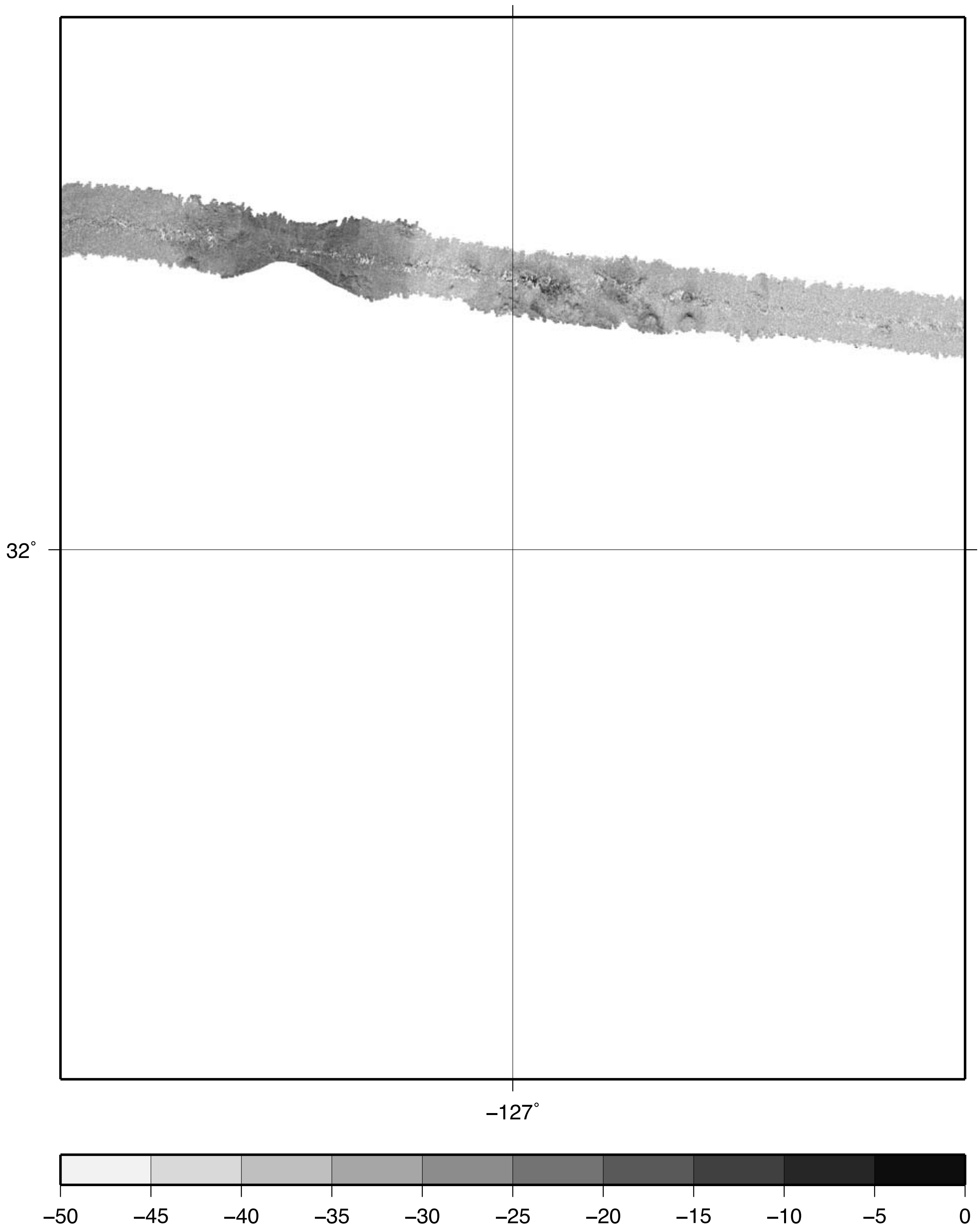
32˚
–129˚
09:00/345
12:00
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000

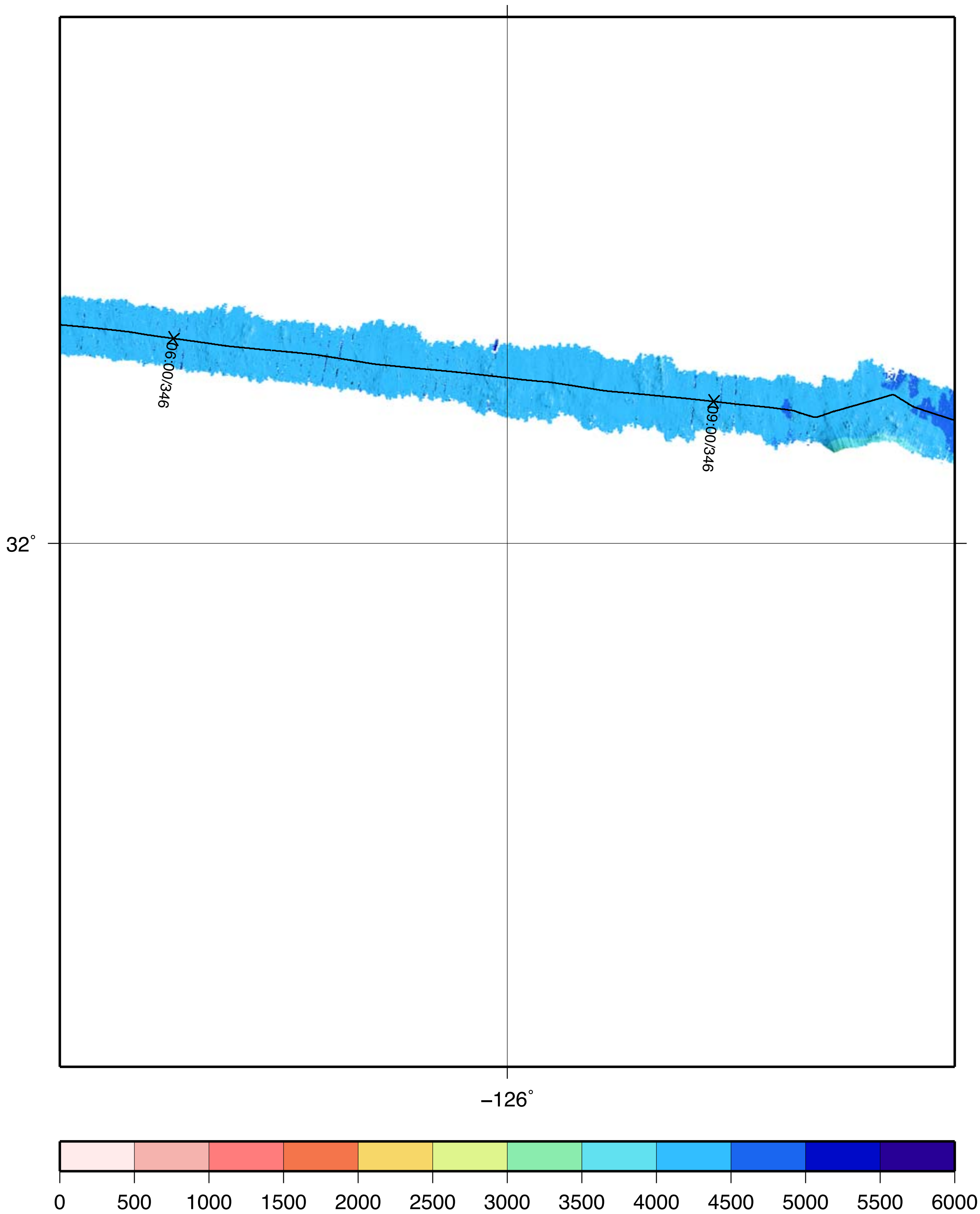

32˚
−129˚
−50
−45
−40
−35
−30
−25
−20
−15
−10
−5
0


33˚
32˚
−128˚
21:00/345
18:00/345
00:00/346
15:00/345
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000

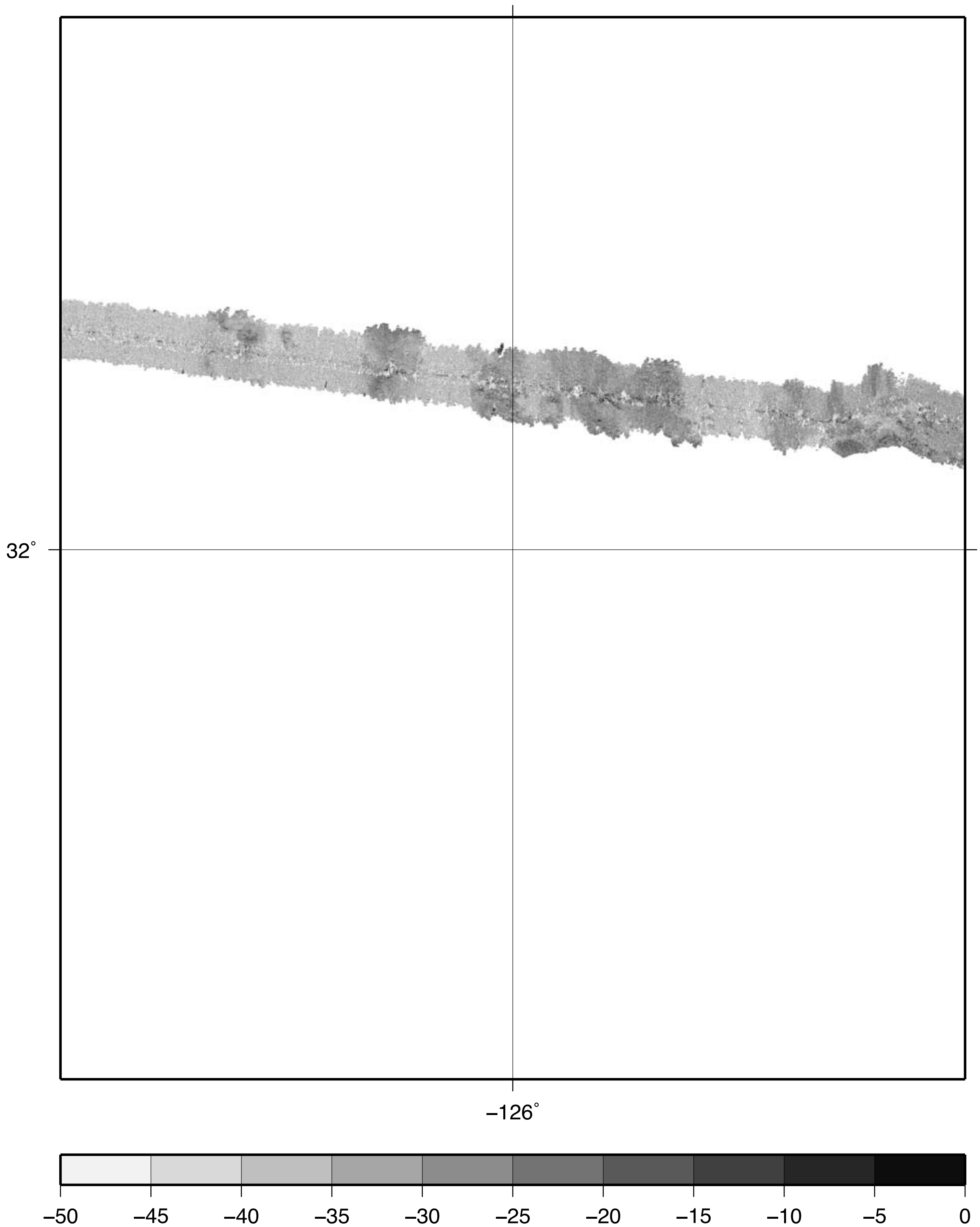

33°
32°
−128°
−50
−45
−40
−35
−30
−25
−20
−15
−10
−5
0


03:00/346
32˚
−127˚
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000

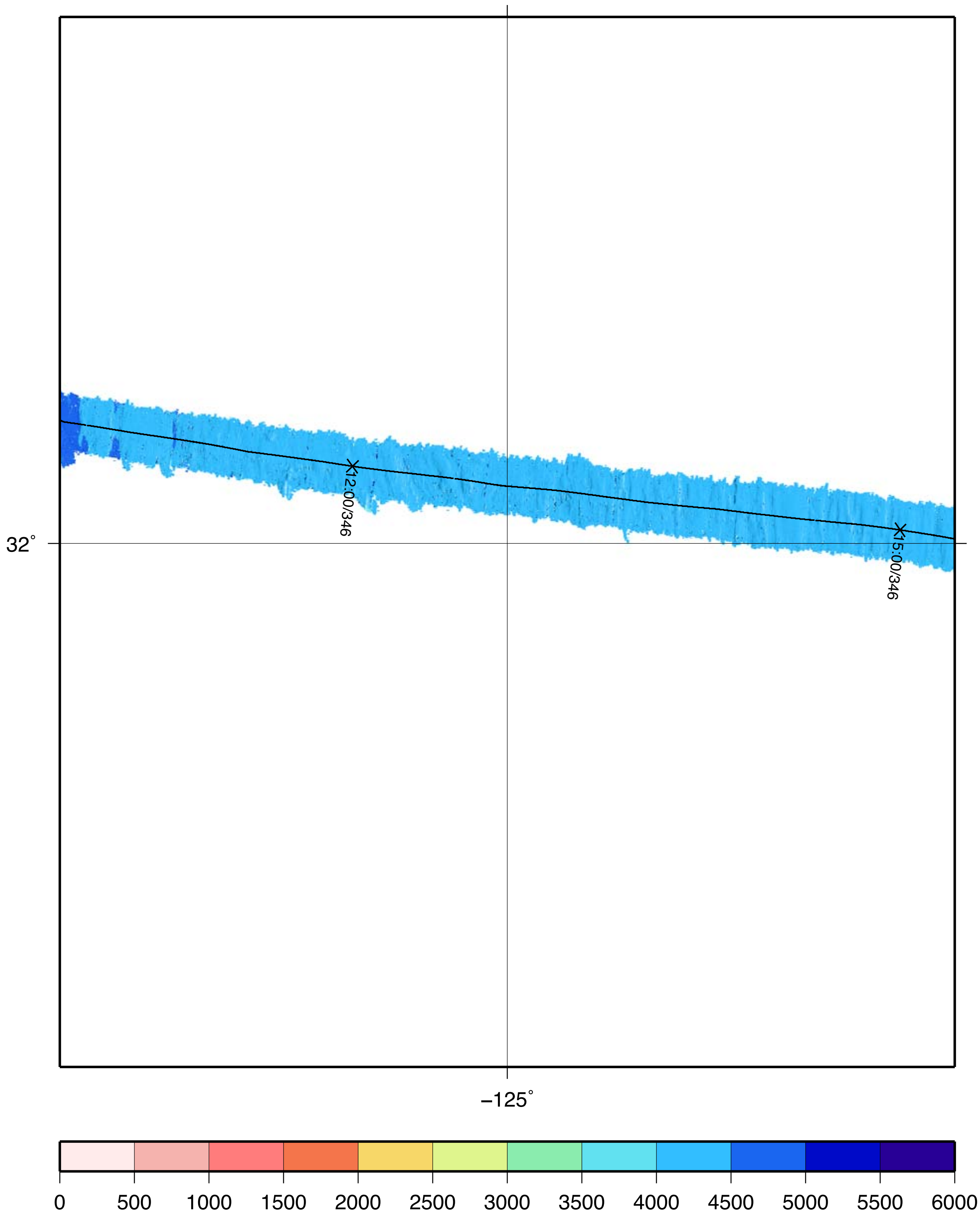

32˚
−127˚
−50
−45
−40
−35
−30
−25
−20
−15
−10
−5
0

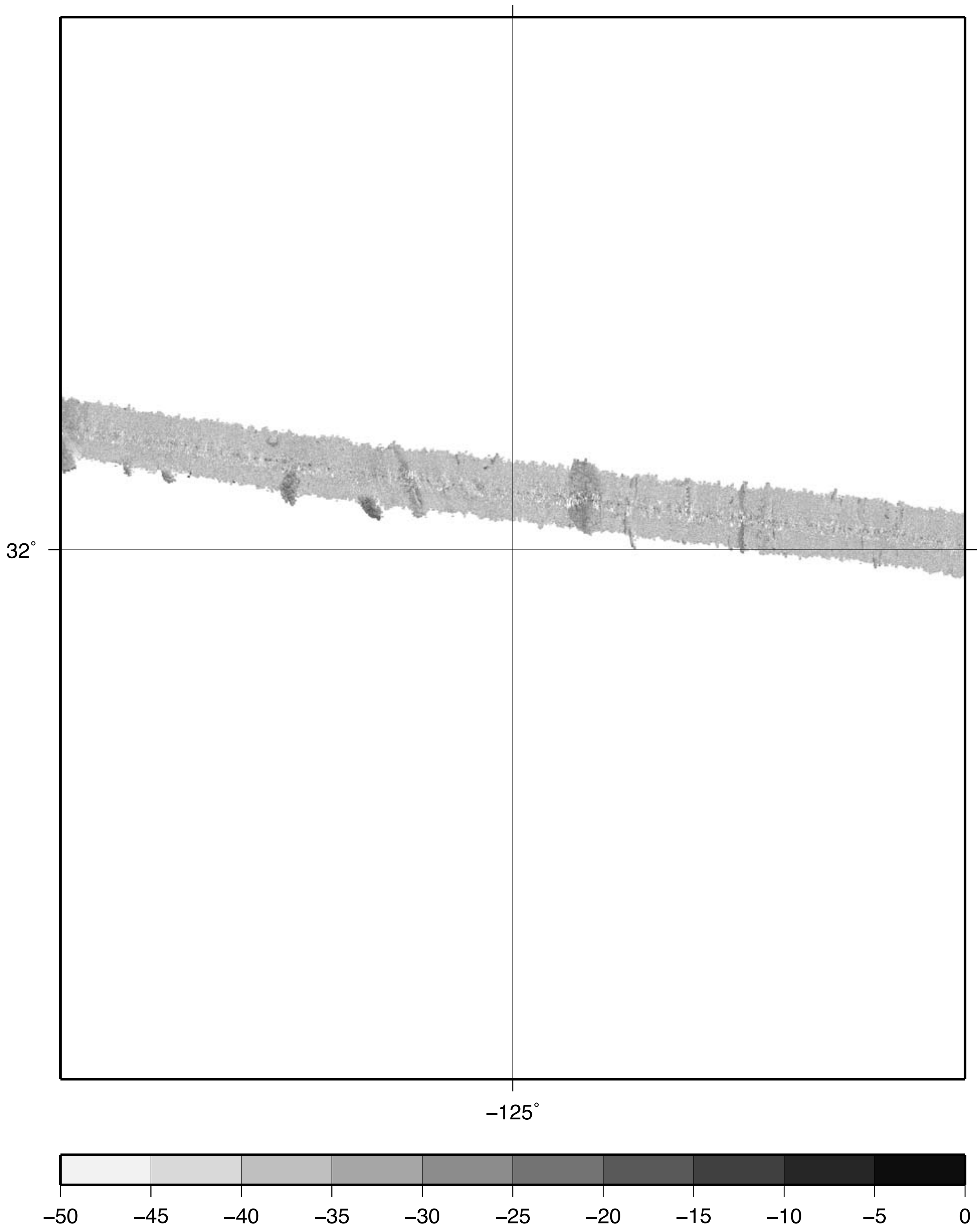


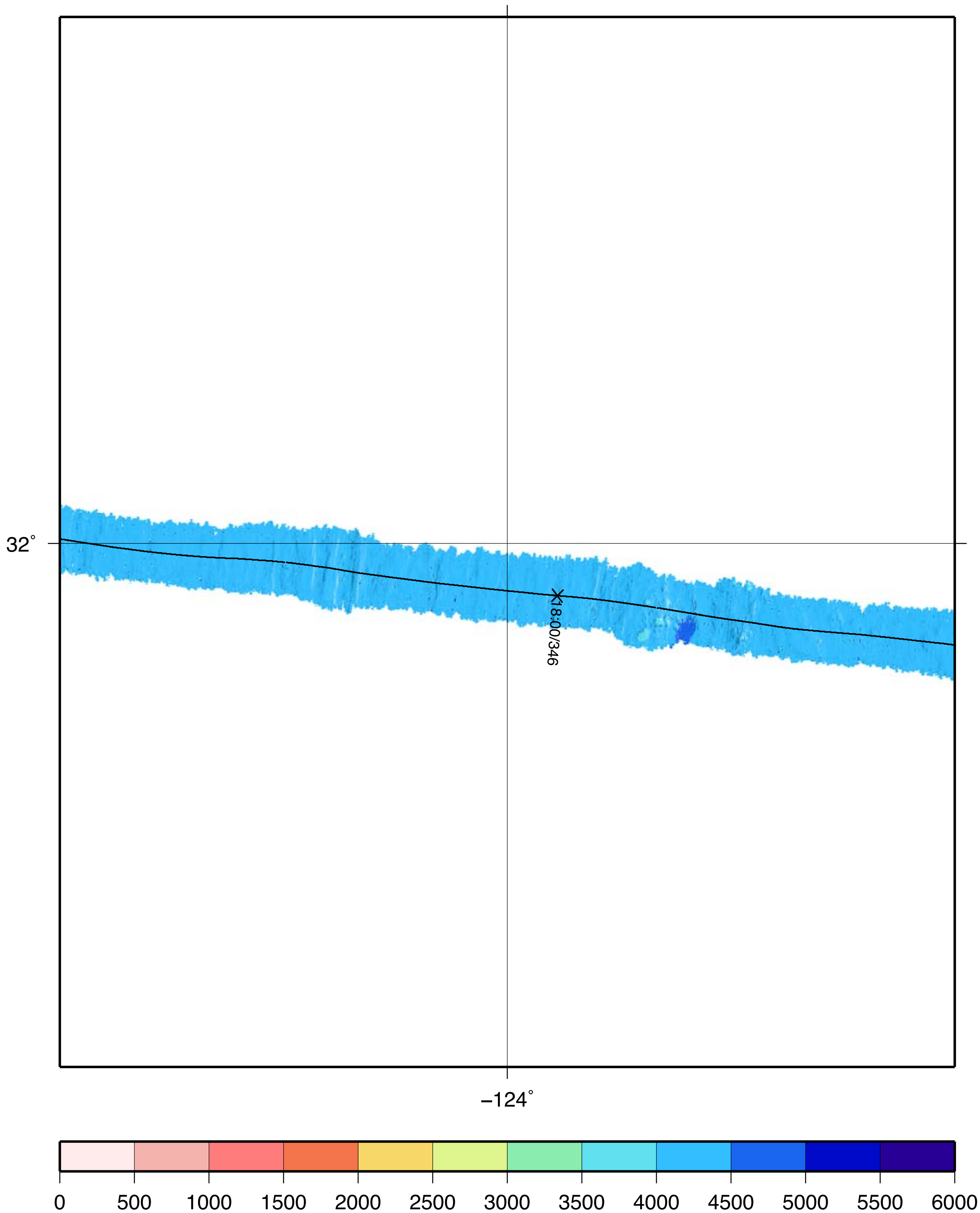
06:00/346
09:00/346
32°
−126°
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000

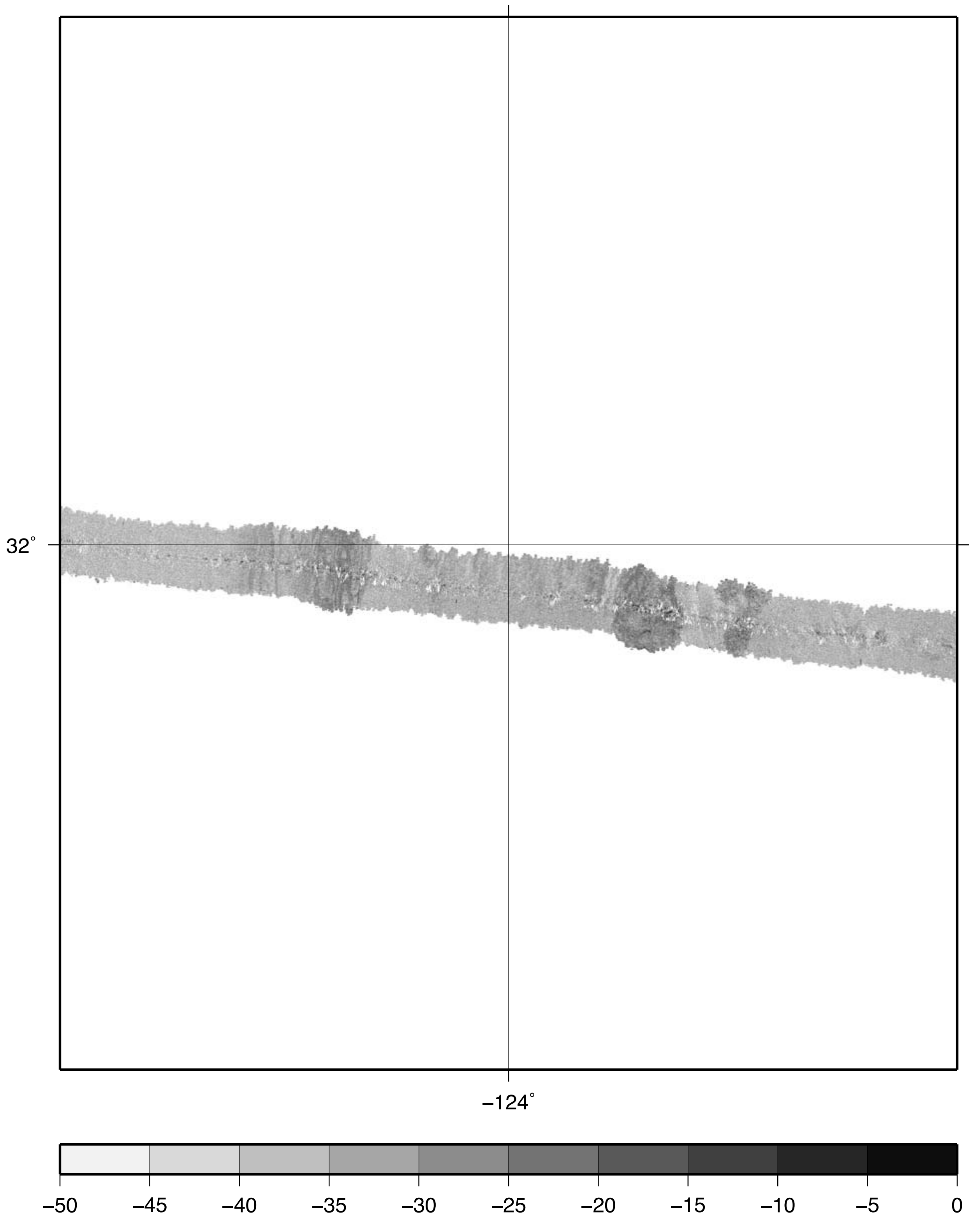


32˚
−126˚
−50
−45
−40
−35
−30
−25
−20
−15
−10
−5
0

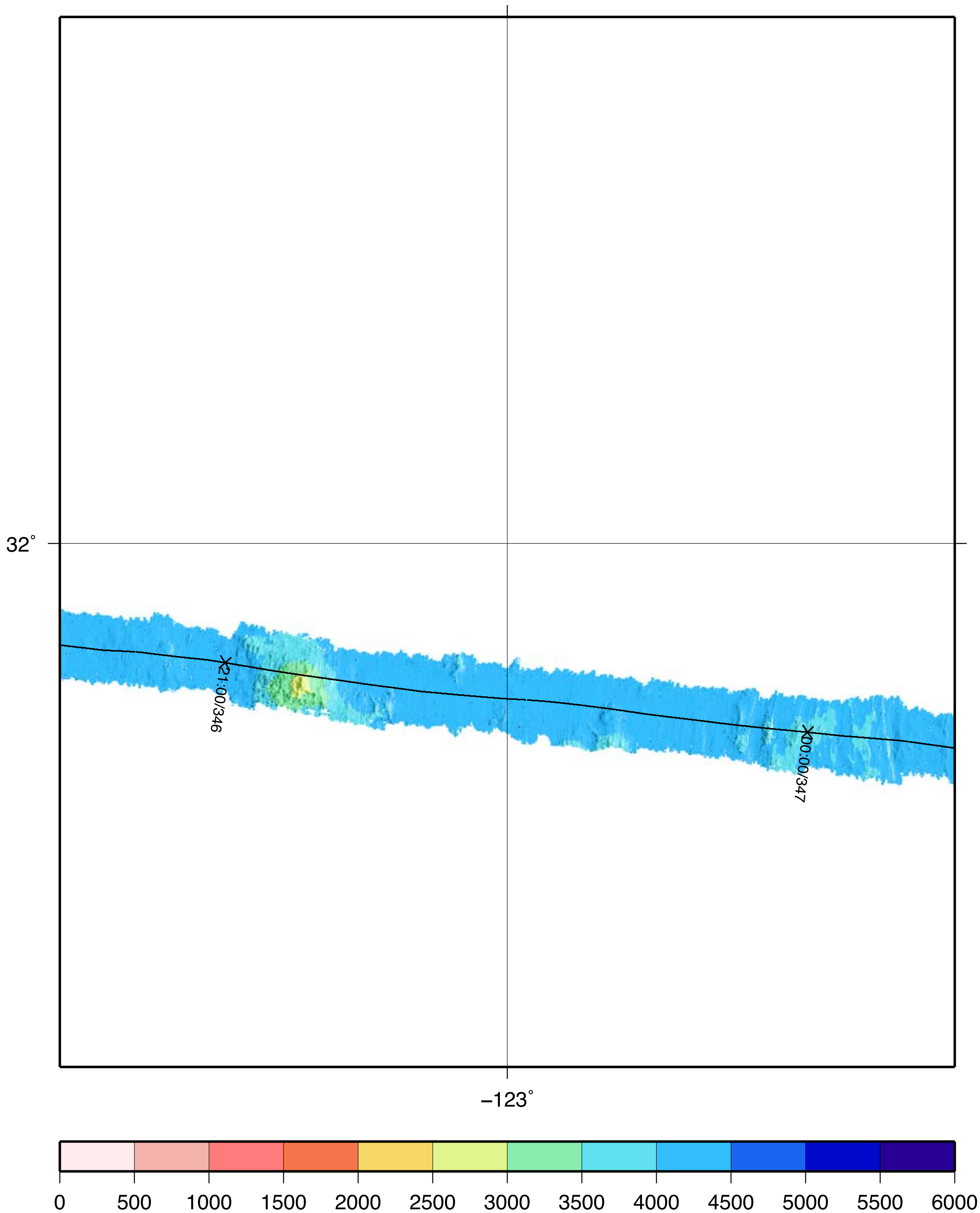

12:00/346
15:0/346
32°
−125°
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000

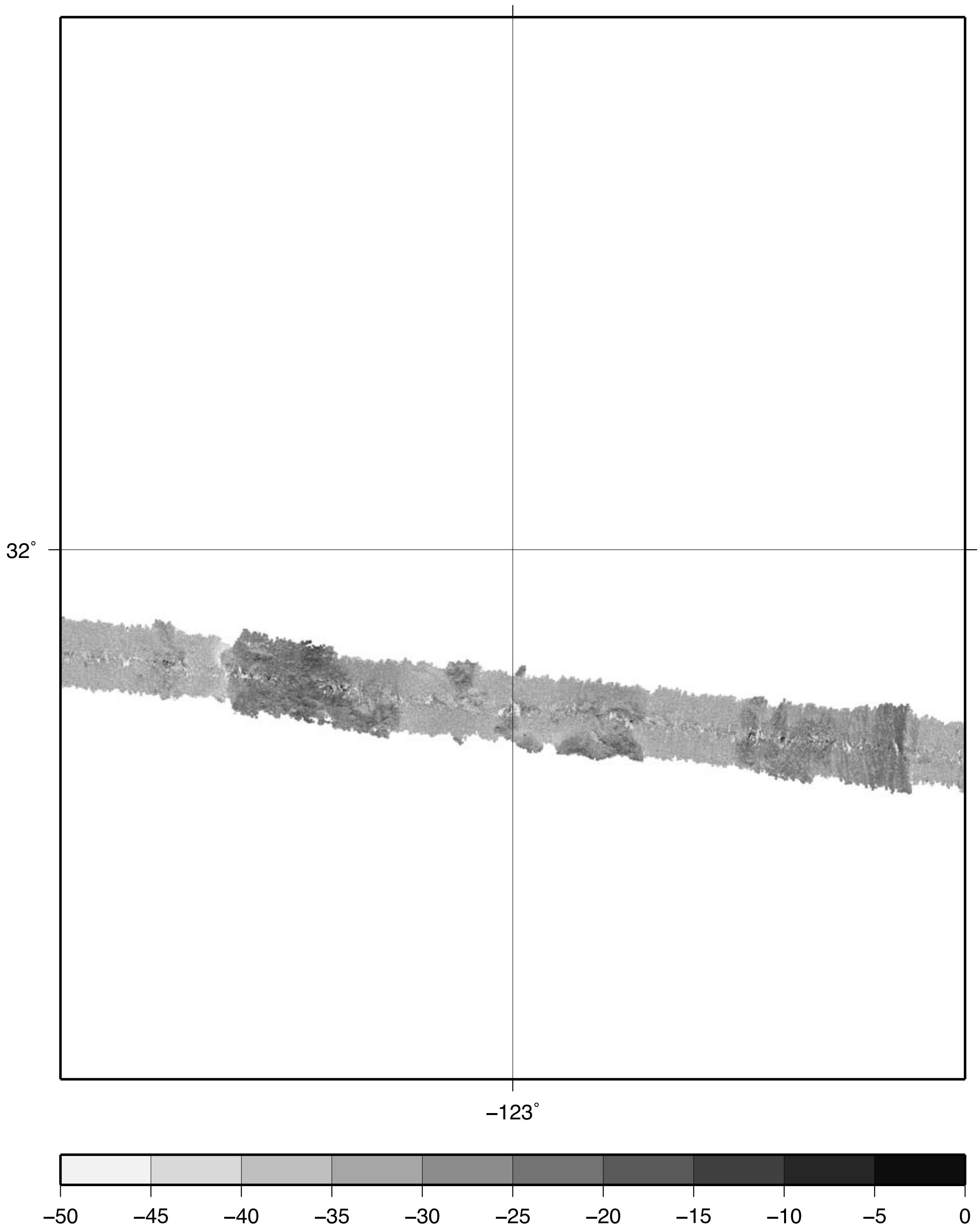

32˚
−125˚
−50
−45
−40
−35
−30
−25
−20
−15
−10
−5
0


32˚
18:00/346
−124˚
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000

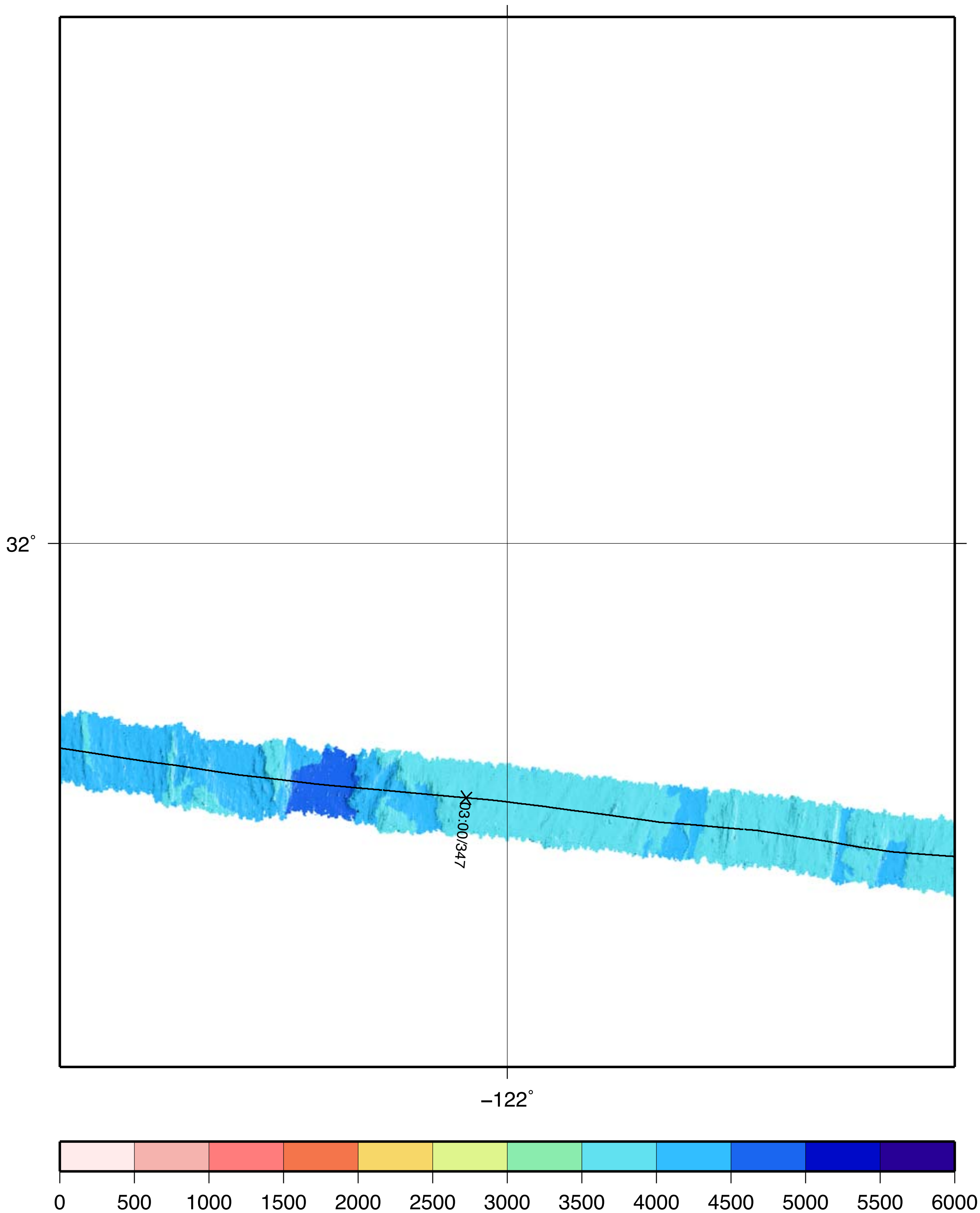


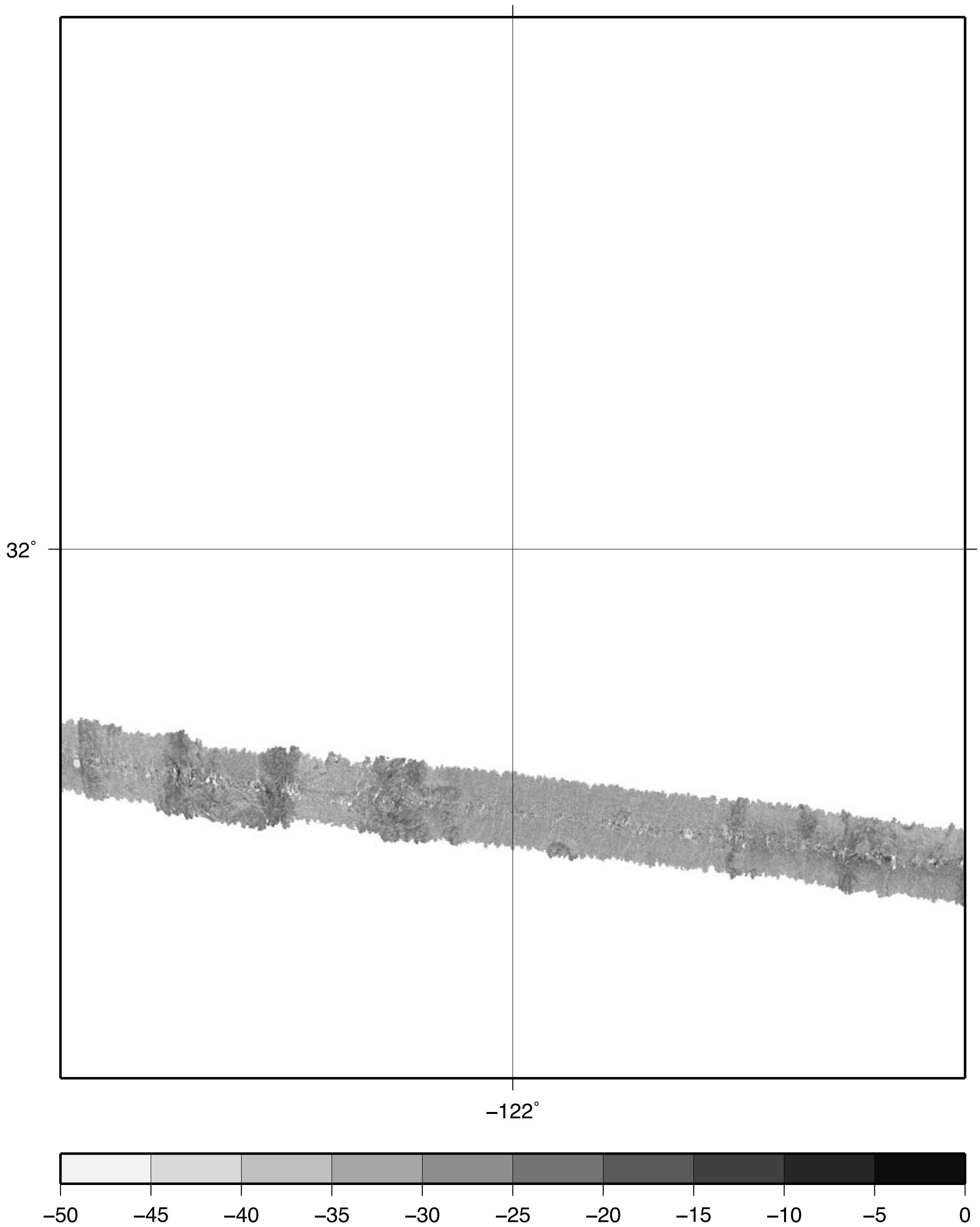
32˚
−124˚
−50
−45
−40
−35
−30
−25
−20
−15
−10
−5
0

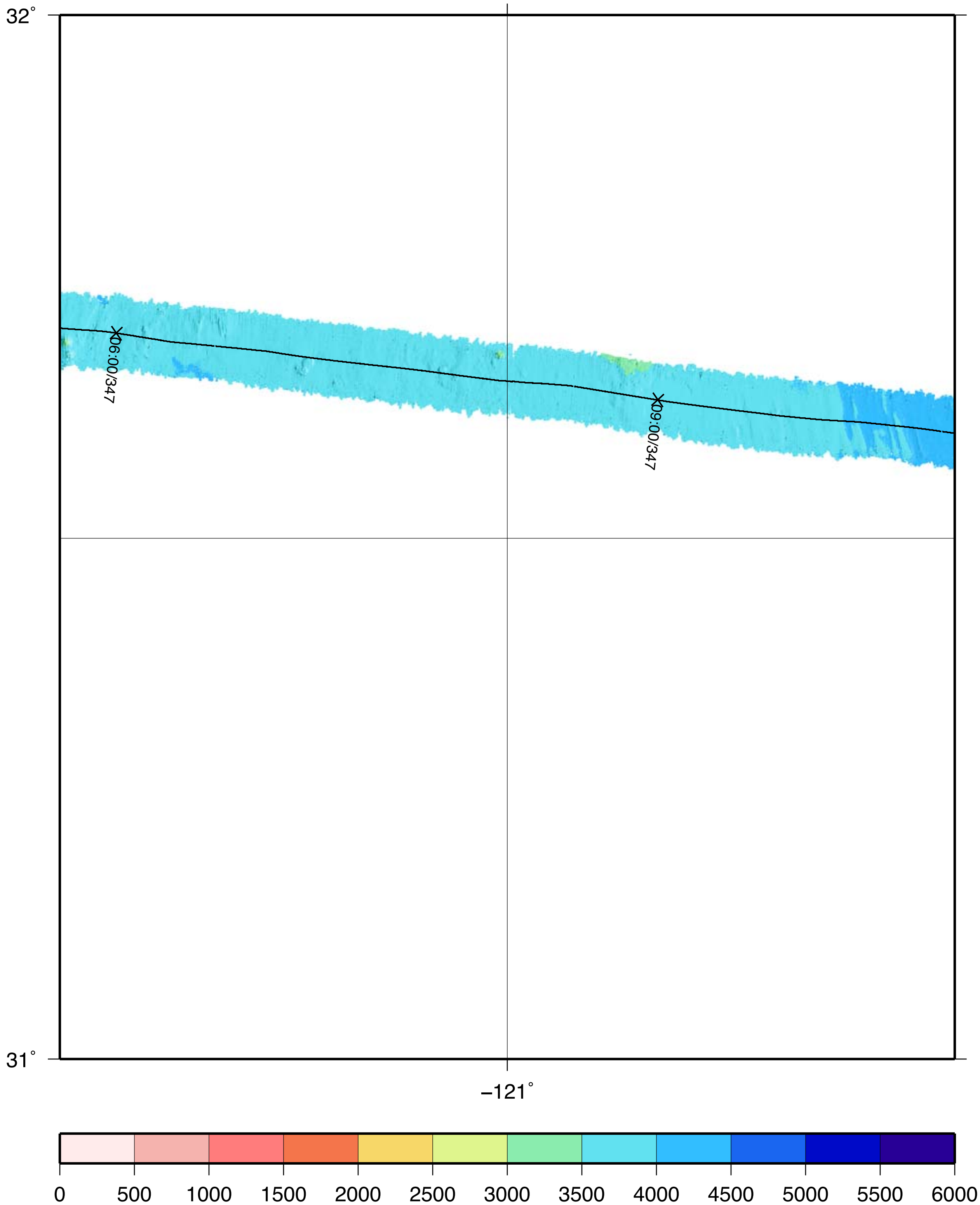

32˚
21:00/346
00:00/347
−123˚
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000



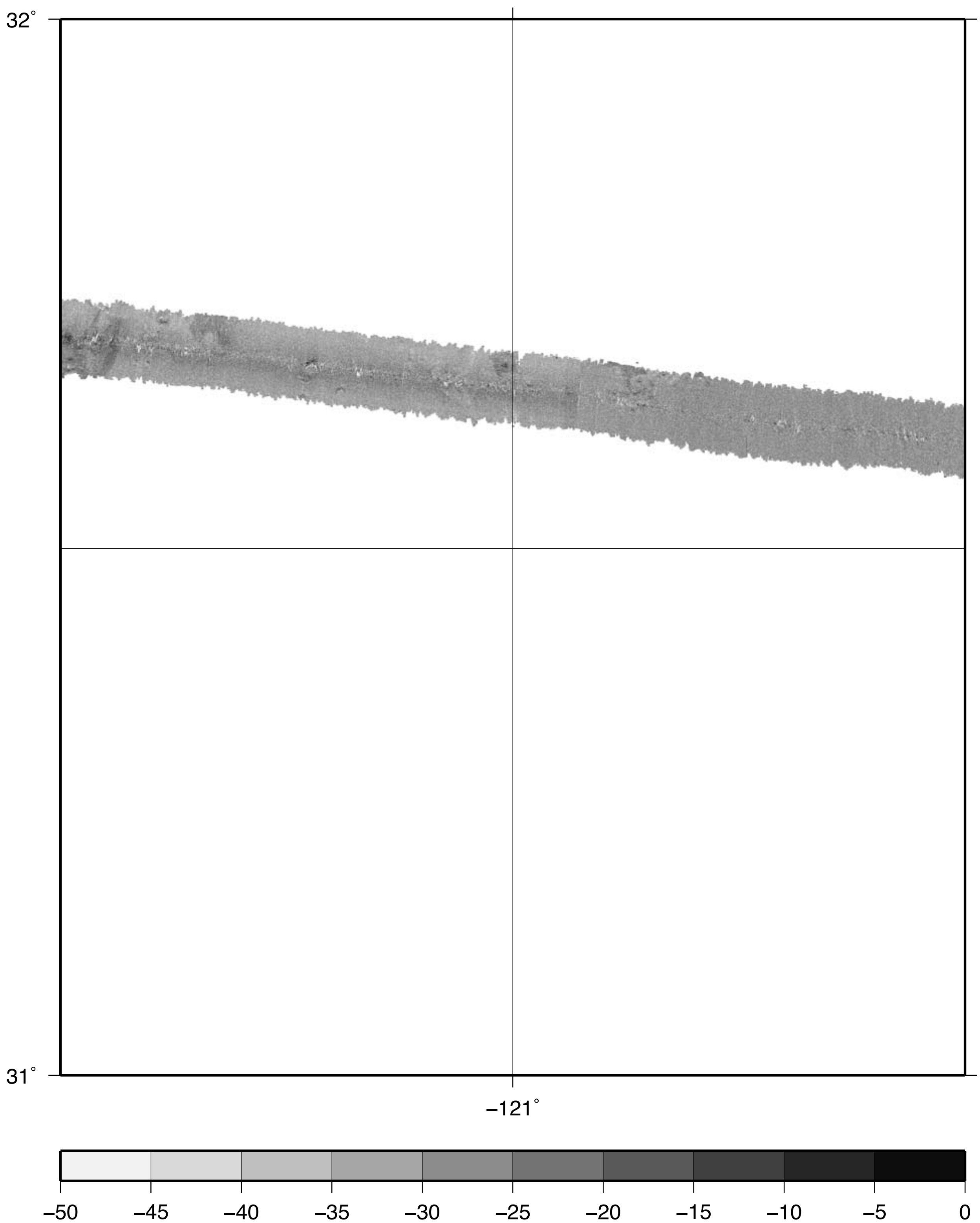
32˚
−123˚
−50
−45
−40
−35
−30
−25
−20
−15
−10
−5
0

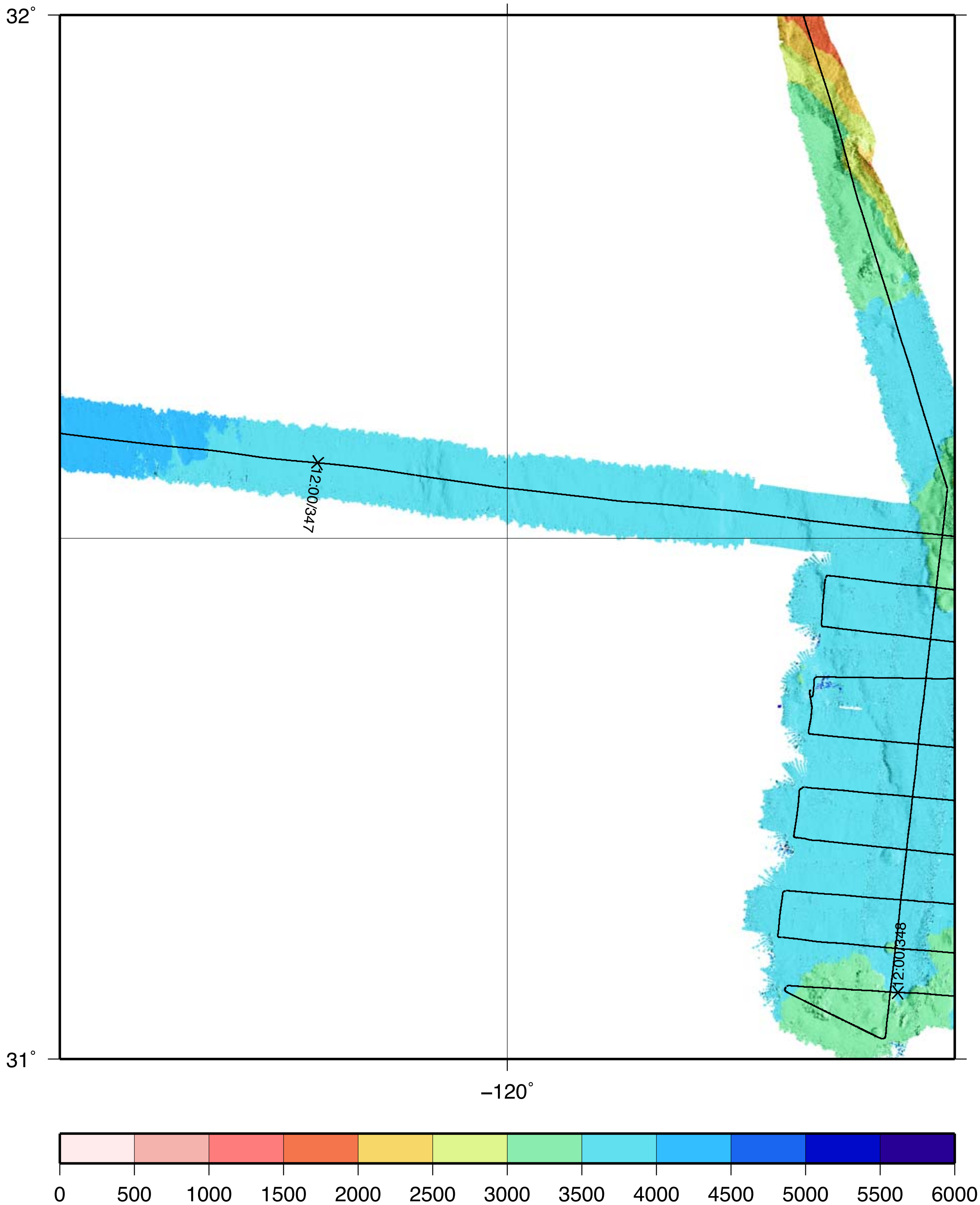

32˚
03:00/347
–122˚
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000


32°
−122°
−50
−45
−40
−35
−30
−25
−20
−15
−10
−5
0

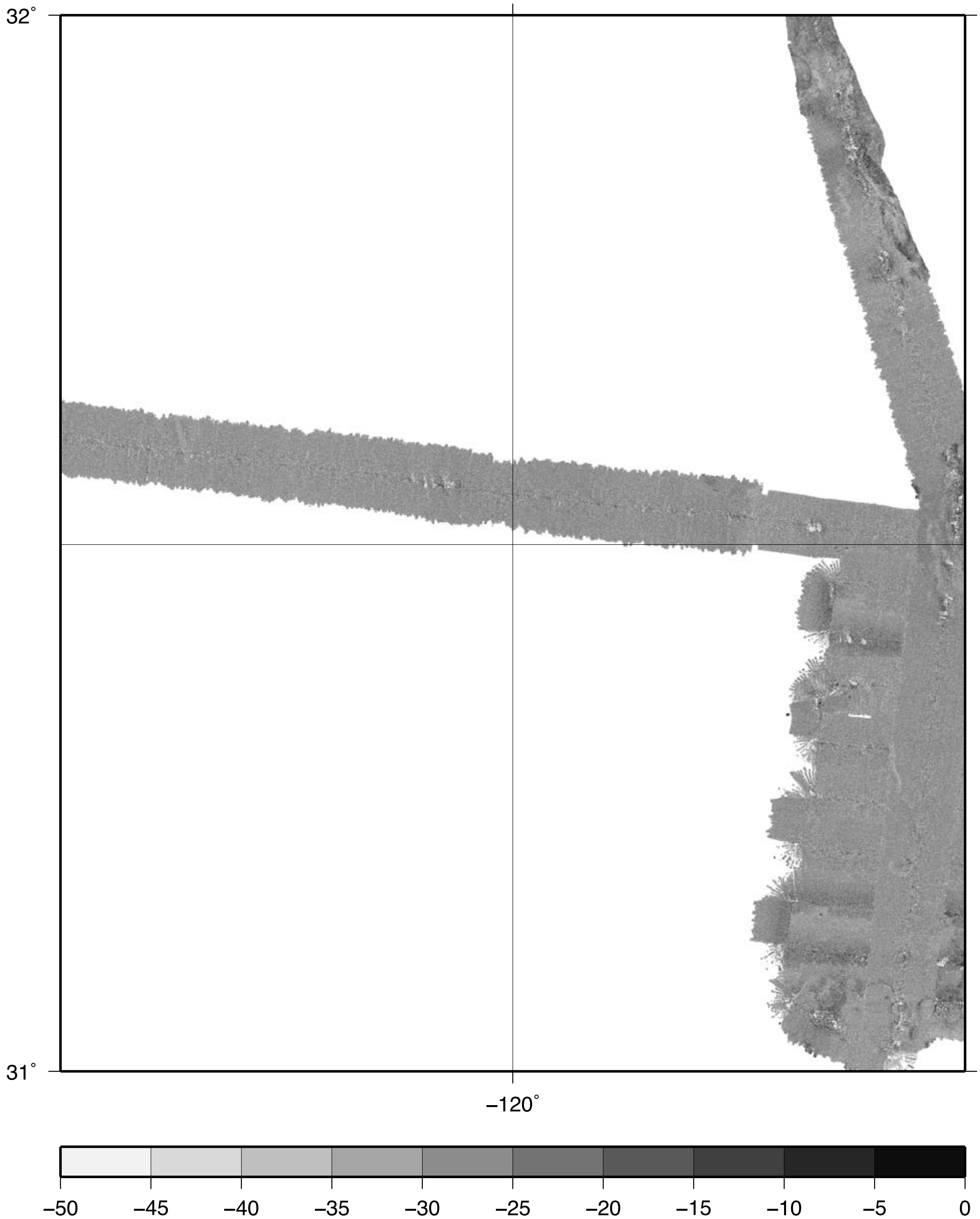


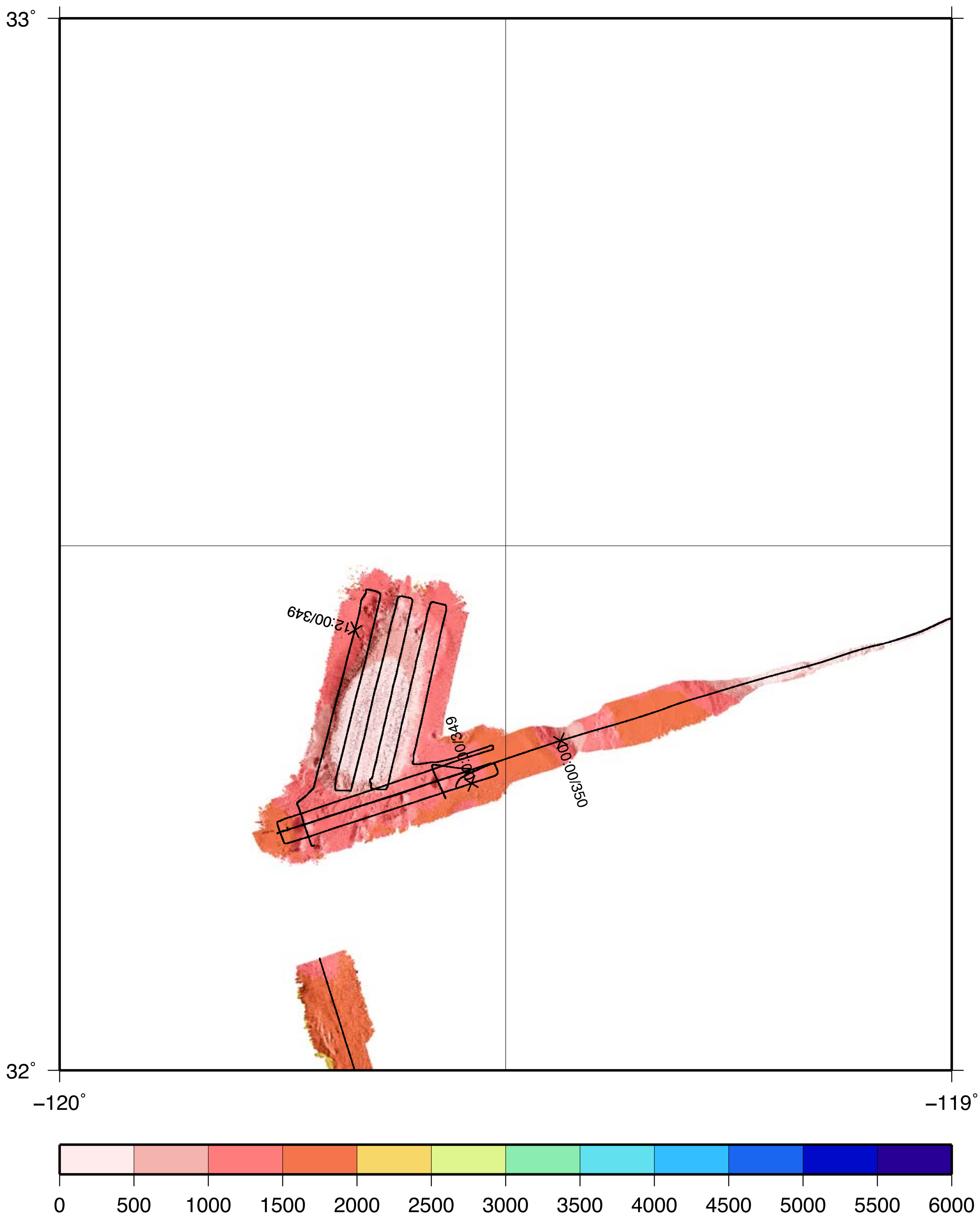
32°
31°
-121°
06:00/347
09:00/347
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000

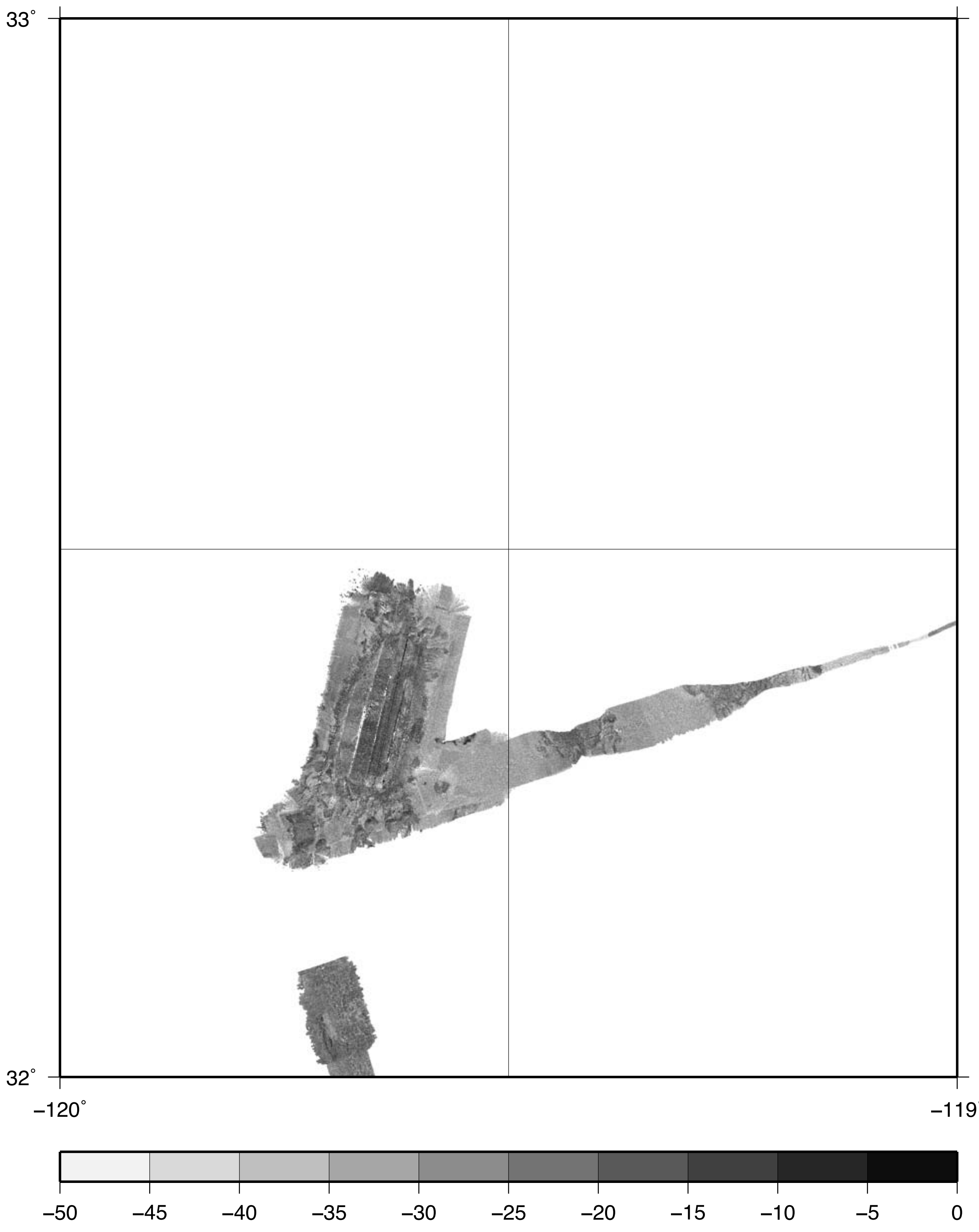

32˚
31˚
−121˚
−50
−45
−40
−35
−30
−25
−20
−15
−10
−5
0

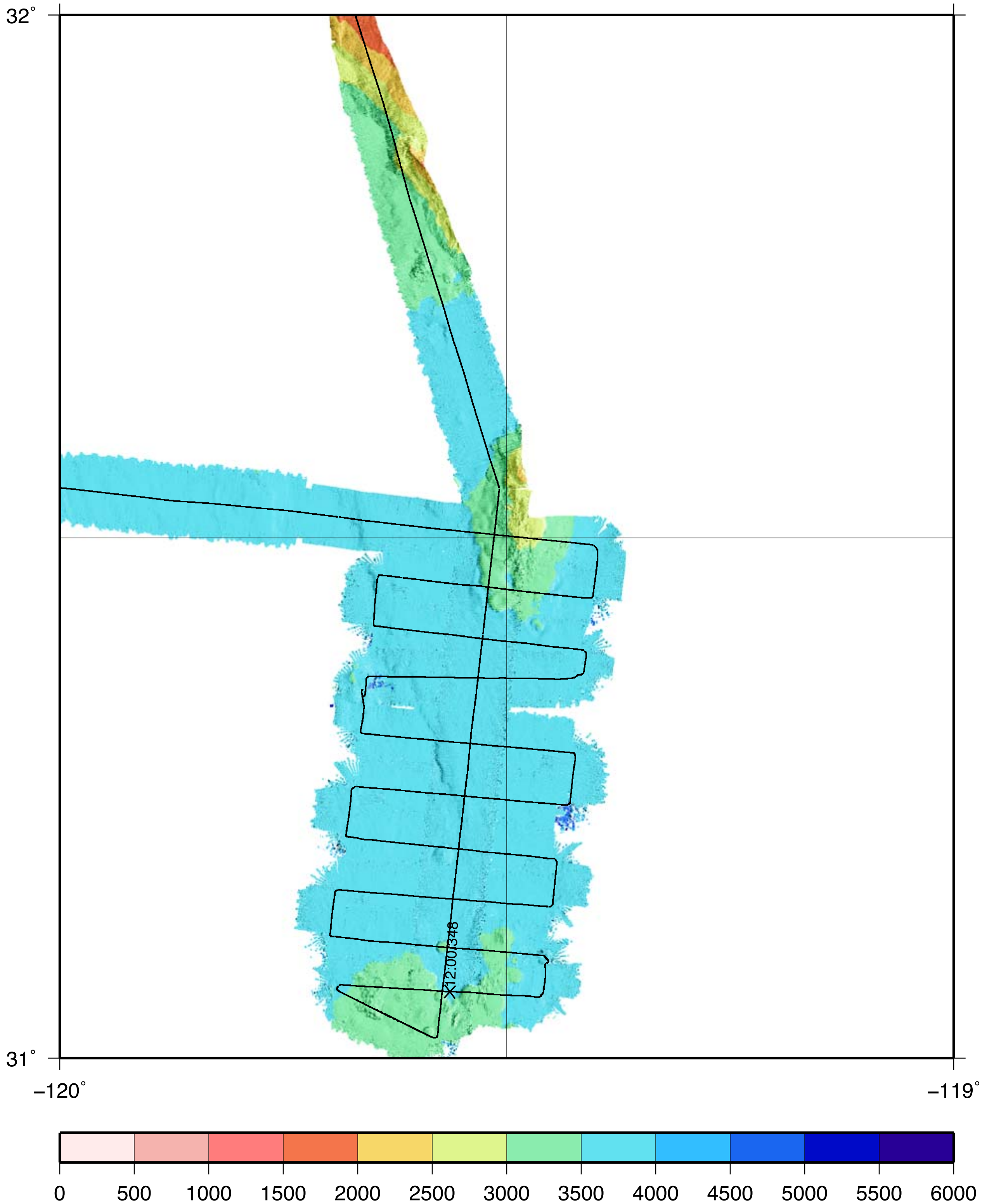


32˚
31˚
–120˚
12:00/347
12:00/348
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000

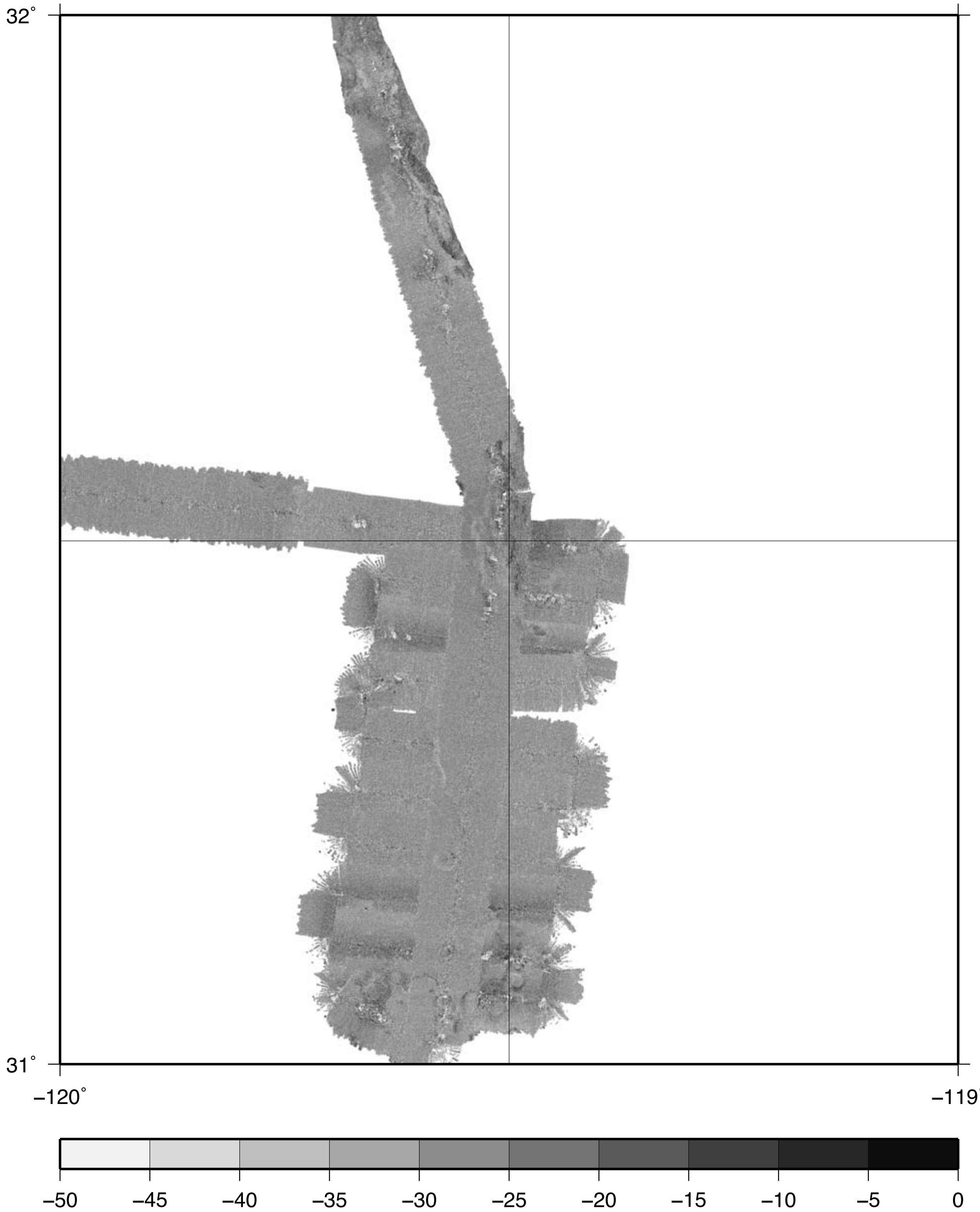

32˚
31˚
−120˚
−50
−45
−40
−35
−30
−25
−20
−15
−10
−5
0


33˚
32˚
−120˚
−119˚
12:00/349
00:00/349
00:00/350
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000

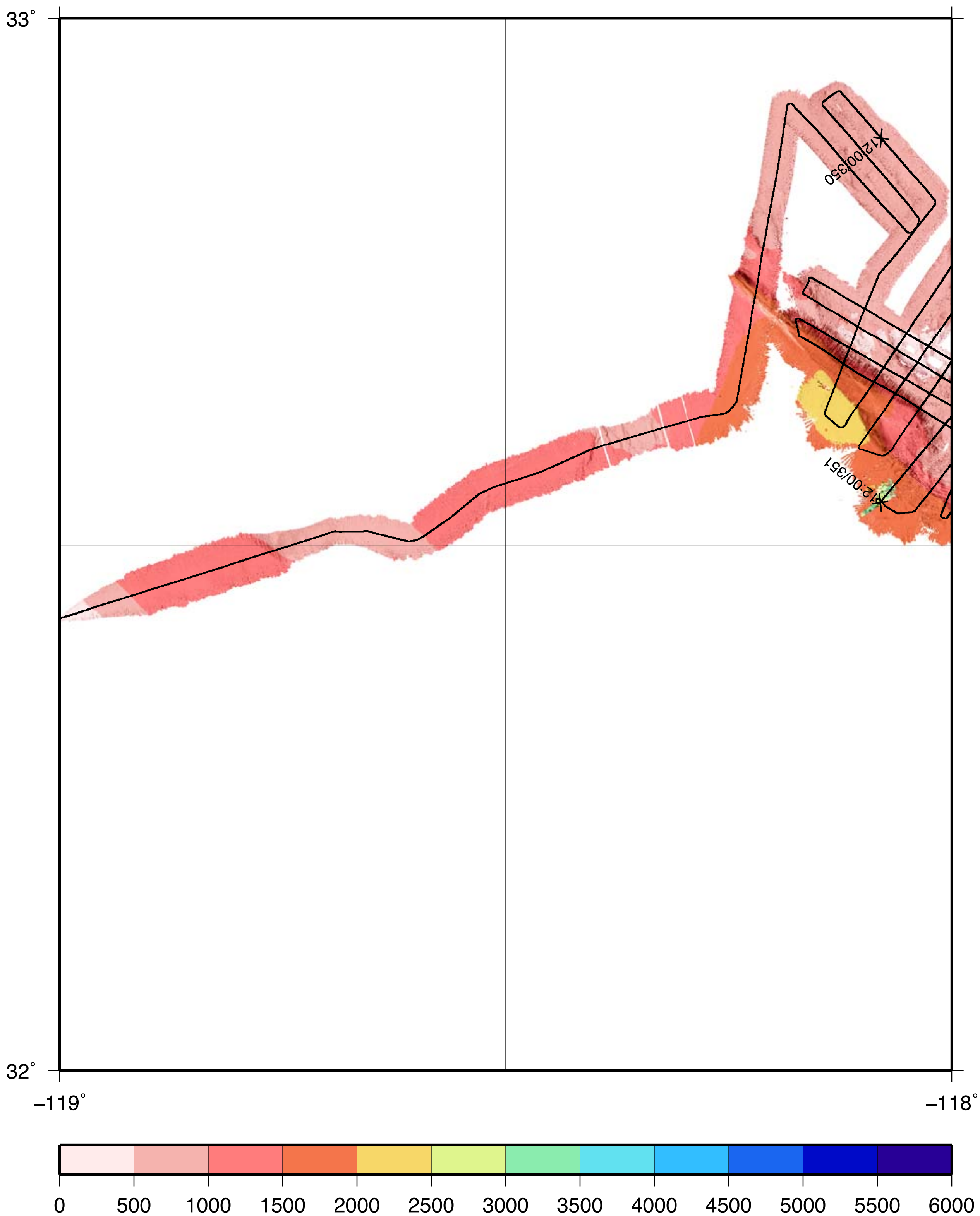

33˚
32˚
−120˚
−119˚
−50
−45
−40
−35
−30
−25
−20
−15
−10
−5
0



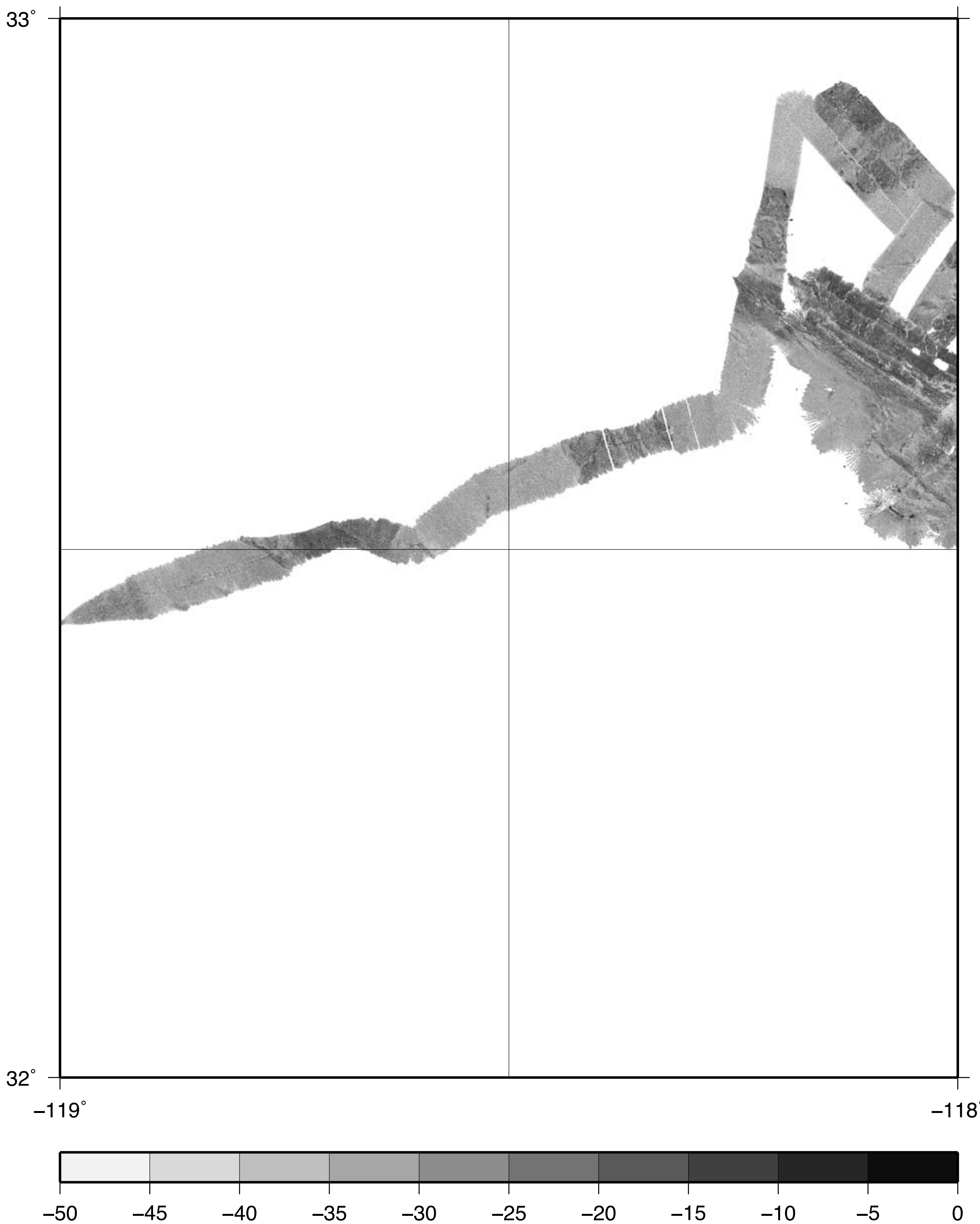
32°
31°
–120°
–119°
12:00/348
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000

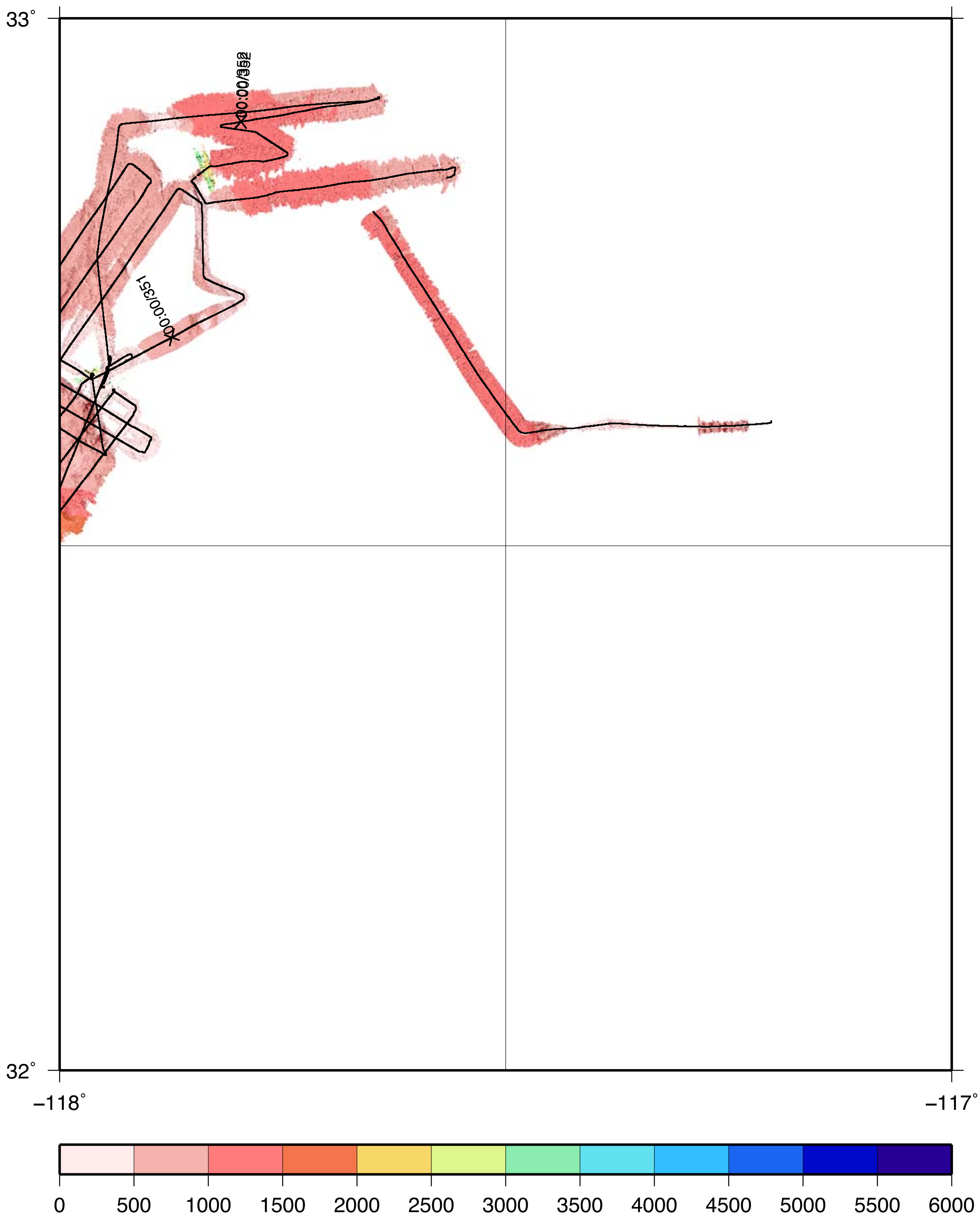


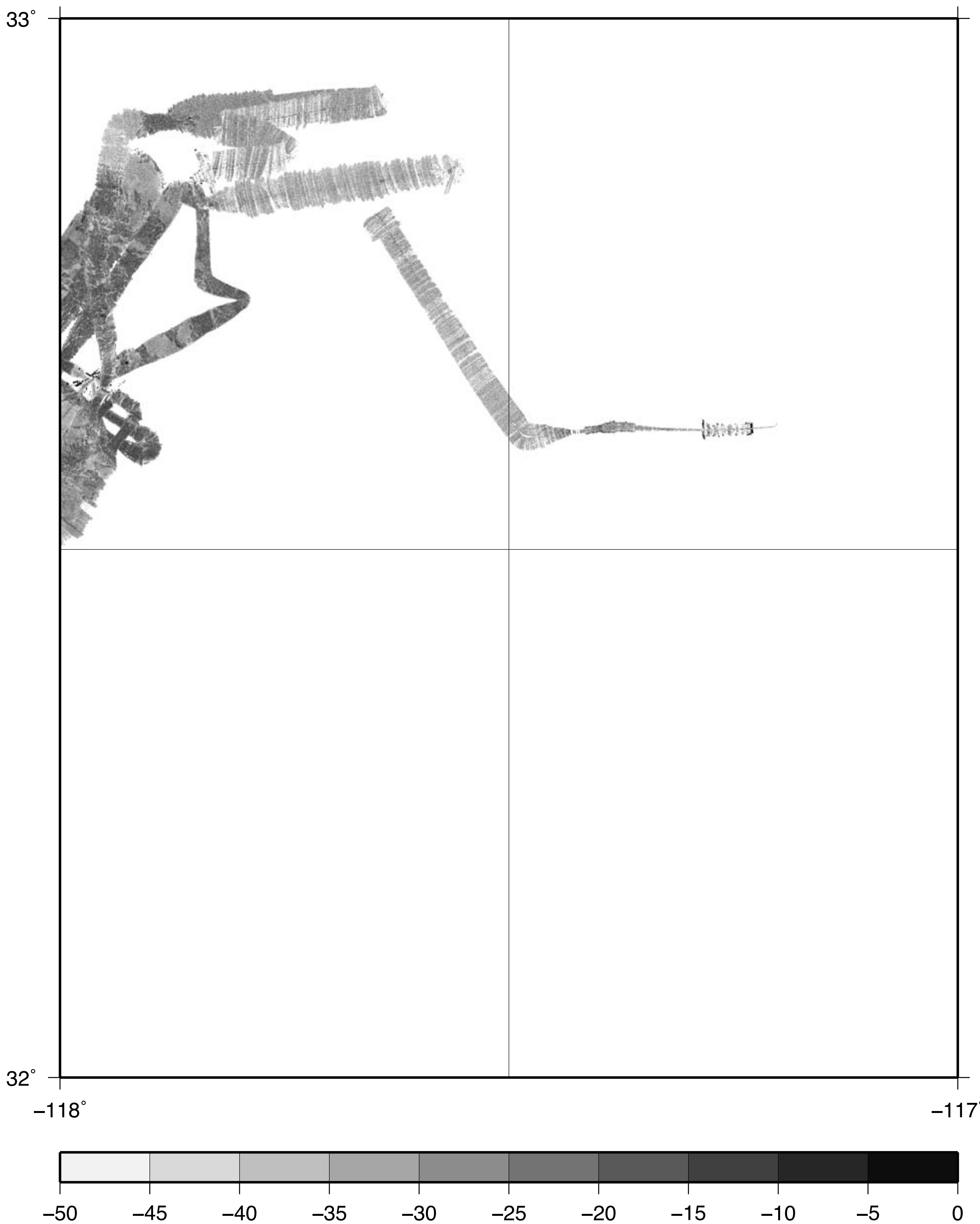
32°
31°
−120°
−119°
−50
−45
−40
−35
−30
−25
−20
−15
−10
−5
0



33˚
32˚
−119˚
−118˚
12:00/350
12:00/351
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000


33˚
32˚
−119˚
−118˚
−50
−45
−40
−35
−30
−25
−20
−15
−10
−5
0


33˚
32˚
–118˚
–117˚
00:00/352
00:00/351
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000



33˚
32˚
−118˚
−117˚
−50
−45
−40
−35
−30
−25
−20
−15
−10
−5
0

Appendix E - XBT and CTD Locations

	XBTs	Date	Time (Z)	Latitude	Longitude	Serial Number	
	T7_00095.RDF	Dec 3, 2016	11:53 PM	23 17.55493N	156 31.83691W	1154642	
	T7_00096.RDF	Dec 7, 2016	8:37 PM	26 51.3042N	140 37.21191W	1154643	
	T7_00097.RDF	Dec 8, 2016	11:26 PM	28 57.76636N	135 9.05078W	1154644	
	T7_00098.RDF	Dec 8, 2016	11:31 PM	28 58.17432N	135 8.1582W	1154645	
	T7_00099.RDF	Dec 10, 2016	4:23 PM	32 23.52393N	127 47.41504W	??????	
	T7_00100.RDF	Dec 10, 2016	6:24 PM	32 31.83667N	127 34.12988W	1154648	
	T7_00101.RDF	Dec 13, 2016	10:39 PM	32 15.05347N	119 40.08496W	1154649	
	T7_00102.RDF	Dec 15, 2016	11:47 AM	32 54.28198N	118 5.85449W	??????	
	T7_00103.RDF	Dec 15, 2016	11:38 PM	32 43.00977N	117 49.90625W	1154650	
	CTD					**Temperature SN**	**Conductivity SN**
	SKQ201616T001.hdr	Dec 3, 2016	12:12 PM	22 42.92 N	158 01.58 W	5773	2251
	SKQ201616T002.hdr	Dec 12, 2016	10:56 PM	31 21.04 N	119 39.53 W	5773	2251

Appendix F - Gravity Ties

BGM-3 DOCKSIDE CALIBRATION .... BIAS DETERMINATION

BGM-3 S/N: 222 SHIP: RV Sikuliaq

DATE: 2 Dec 2016 PERSONNEL: B. Conkley

~~PORT~~/PIER/BERTH Pier 35 Honolulu

DATE: 12/2/2016 J.D. 337 TIME GMT: 02:00 TO: 02:30 MEAN: ~~24663.74~~ 2:15

from NGA pub. 15_HOSS

....

LAND GRAVITY STA.# : Pier 35 Alpha STATION NAME Pier 35 Alpha

STA GRAVITY VALUE @ PIER LEVEL (from description) 978928.27 MGAL (e.g., 979750.33)

~~WATER HT TO~~ TO METER PIER (in feet) 2 * .094 = + - 0.19 MGAL (e.g., 10.33)

BASE g @ ~~SEA LEVEL~~ meter level 978928.08 MGAL (e.g., 979760.33)

....

SENSOR FACTORY SCALE FACTOR (SF). : 4.949295987 MGAL/PULSE (e.g., 4.999555)

AVG. PULSE COUNTS (PC) (average of 3600 values) 24663.74 PULSE (e.g., 24995.555)

(PC * SF) = 122068.15 MGAL (e.g., 124966.65)
(e.g., 24995.555*4.999555)

BASE g at SL – (PC*SF) = **BIAS =** 856859.93 **MGAL** (e.g., 854793.68)
(e.g., 979760.33-124966.65)

TIME ______ WATER HEIGHT TO PIER ______________ feet

TIME ______ WATER HEIGHT TO PIER ______________ feet

TIME ______ WATER HEIGHT TO PIER ______________ feet

AVERAGE WATER HT TO PIER ______________ feet

COMMENTS

BGM-3 DOCKSIDE CALIBRATION .... BIAS DETERMINATION

BGM-3 S/N: 222

SHIP: Sikuliaq

DATE: 17 December 2016

PERSONNEL: Coakley

PORT/PIER/BERTH San Diego, Pier

DATE: ____ **J.D.** 352 **TIME GMT:** 19:00 **TO:** 19:30 **MEAN:** 19:15

....

LAND GRAVITY STA.# : 032.79 STATION NAME 10th Avenue Terminal; Berth 5

STA GRAVITY VALUE @ PIER LEVEL (from description) 979511.1 MGAL (e.g., 979750.33)

WATER HT TO PIER (in feet) 5.5 * .094 = + -0.517 MGAL (e.g., 10.33)

BASE g @ SEA LEVEL 979510.58 MGAL (e.g., 979760.33)

....

SENSOR FACTORY SCALE FACTOR (SF). : 4.949295987 MGAL/PULSE (e.g., 4.999555)

AVG. PULSE COUNTS (PC) (average of 3600 values) 24781.63 PULSE (e.g., 24995.555)

(PC * SF) = 122651.62 MGAL (e.g., 124966.65)
(e.g., 24995.555*4.999555)

BASE g at SL – (PC*SF) = **BIAS =** 856858.96 **MGAL** (e.g., 854793.68)
(e.g., 979760.33-124966.65)

TIME ______ WATER HEIGHT TO PIER ____________ feet

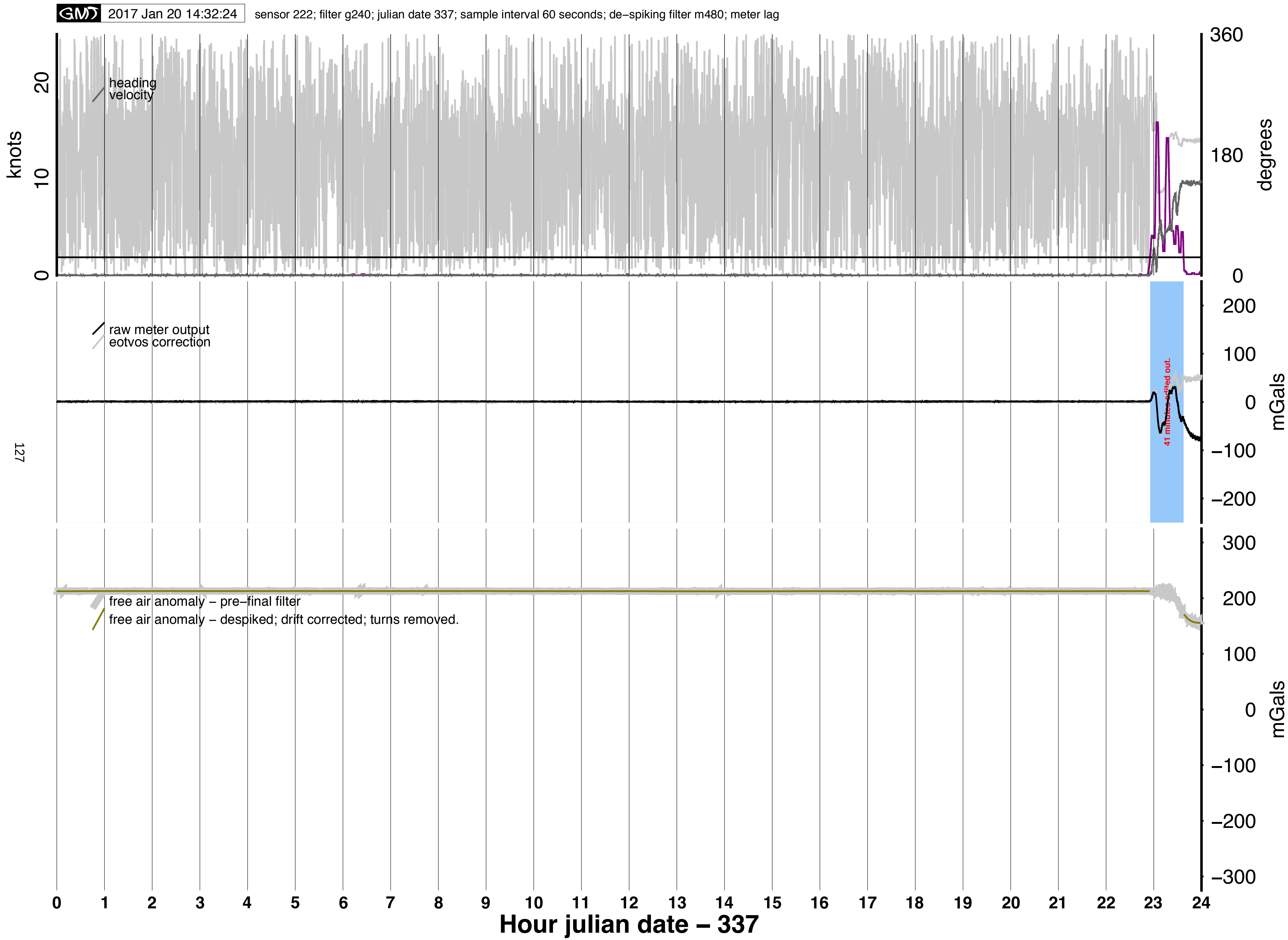
TIME ______ WATER HEIGHT TO PIER ____________ feet

TIME ______ WATER HEIGHT TO PIER ____________ feet

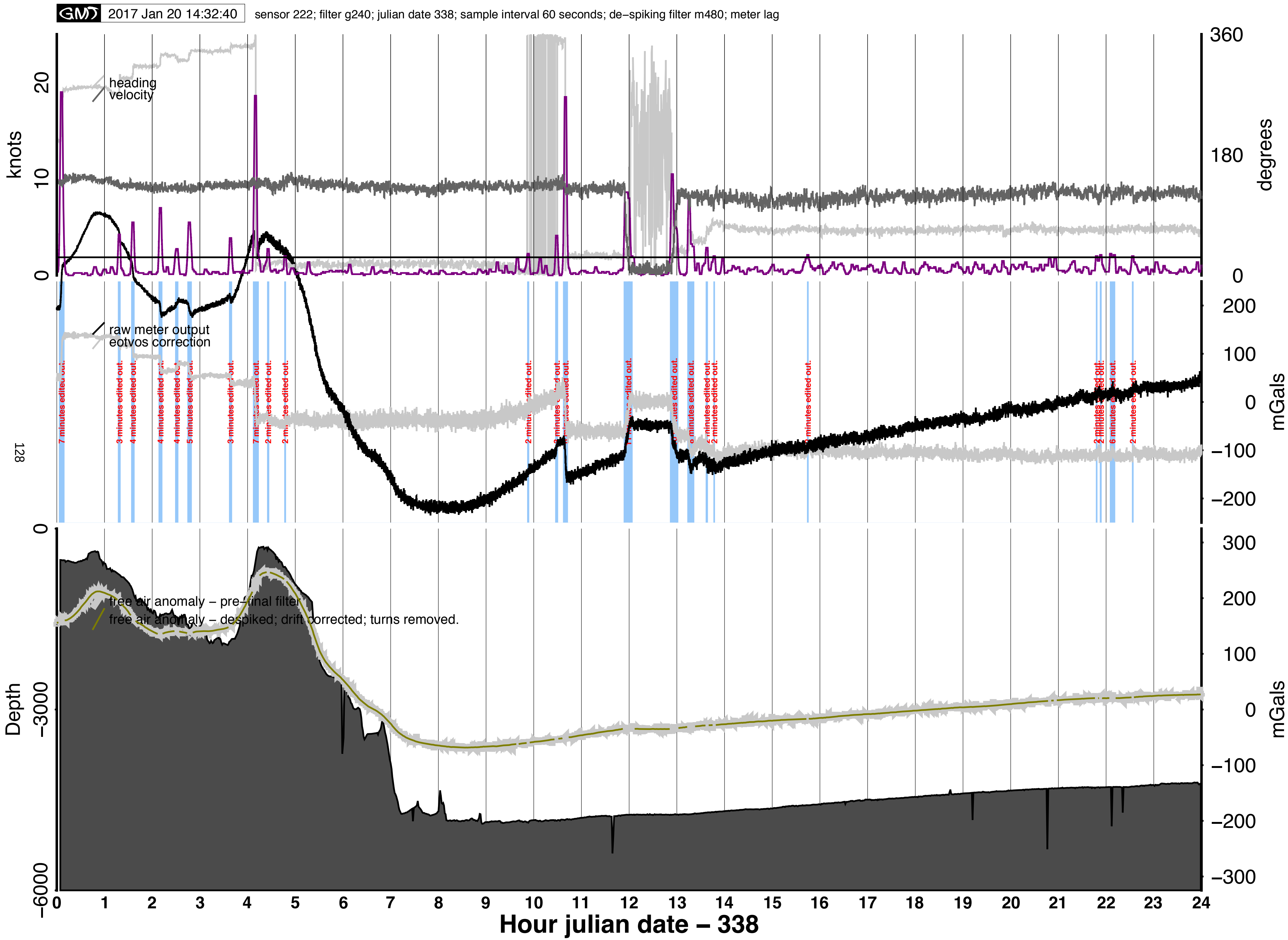
AVERAGE WATER HT TO PIER ____________ feet

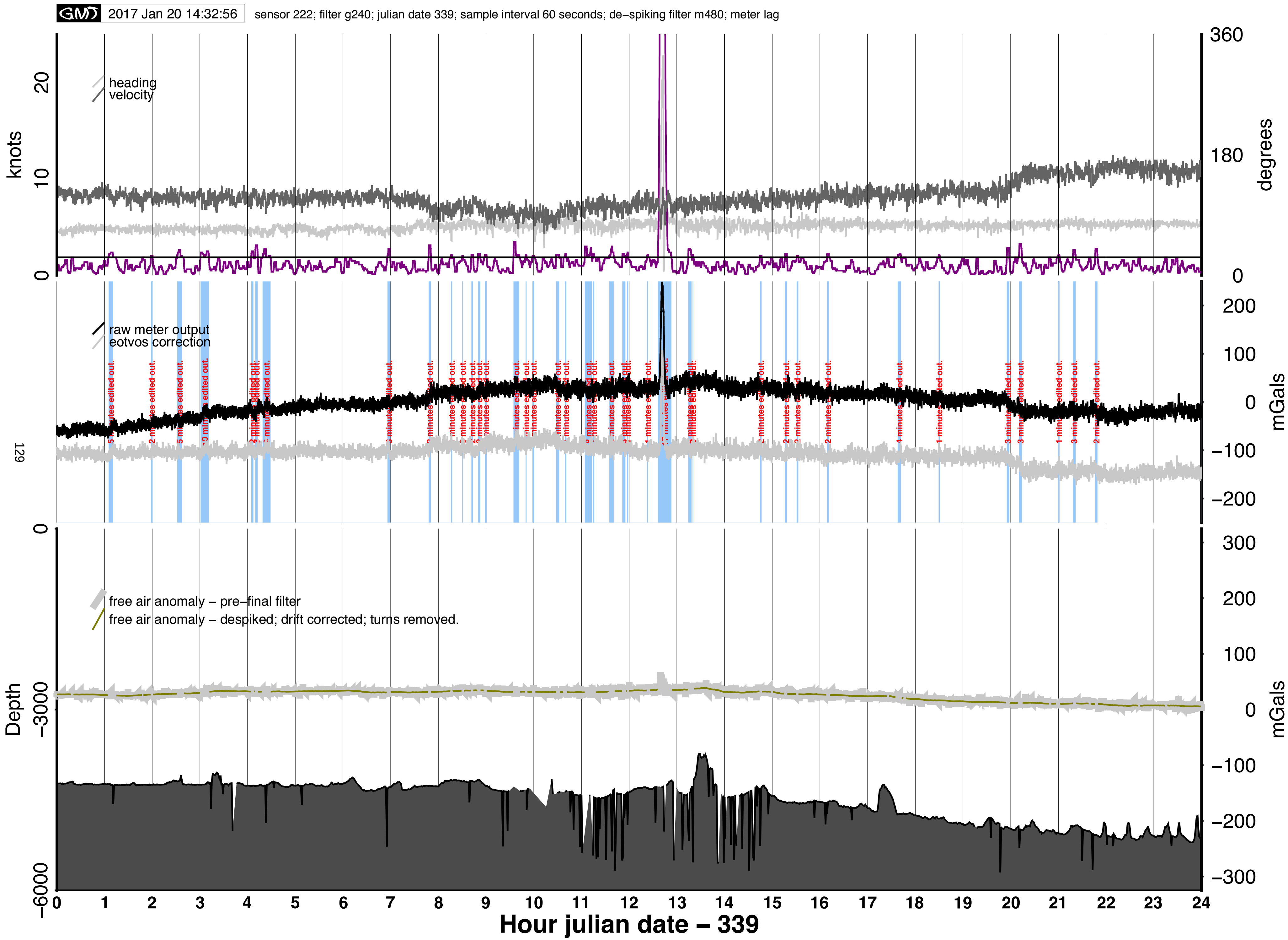
COMMENTS

Appendix G - Gravity Plots

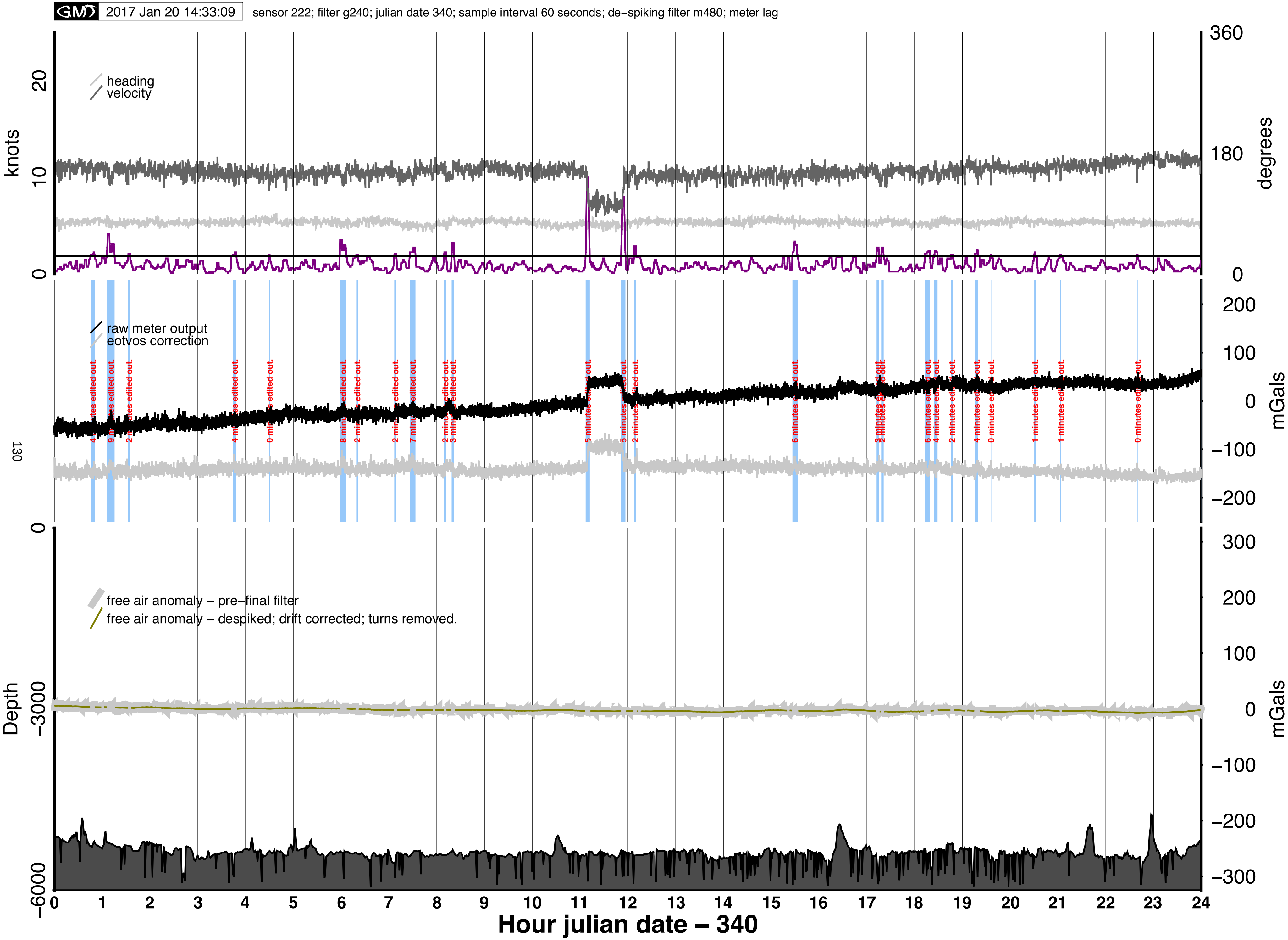


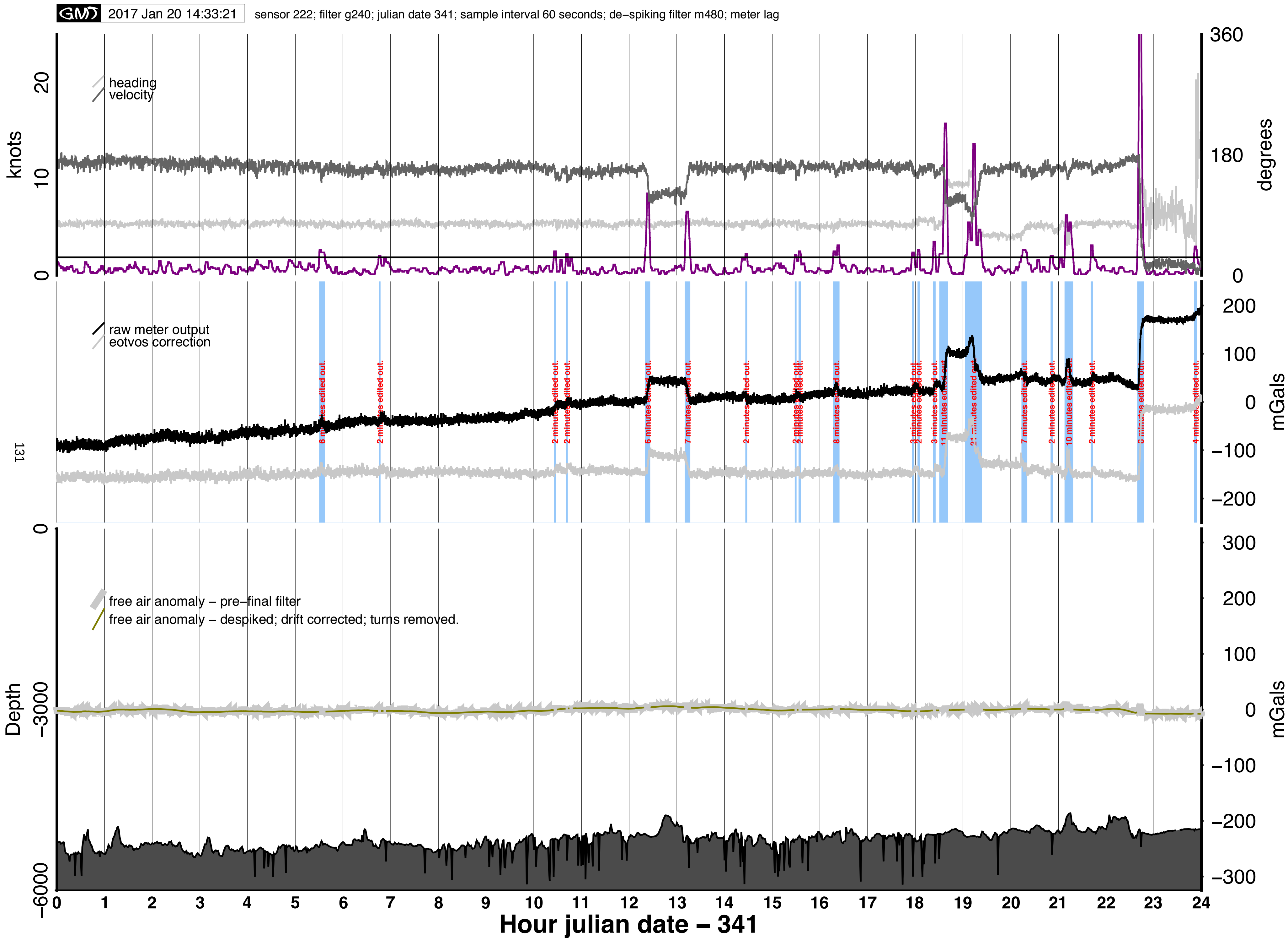
2017 Jan 20 14:32:24
sensor 222; filter g240; julian date 337; sample interval 60 seconds; de−spiking filter m480; meter lag
knots
0
10
20
heading
velocity
degrees
0
180
360
raw meter output
eotvos correction
41 minutes edited out.
mGals
200
100
0
−100
−200
free air anomaly − pre−final filter
free air anomaly − despiked; drift corrected; turns removed.
mGals
300
200
100
0
−100
−200
−300
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
Hour julian date − 337

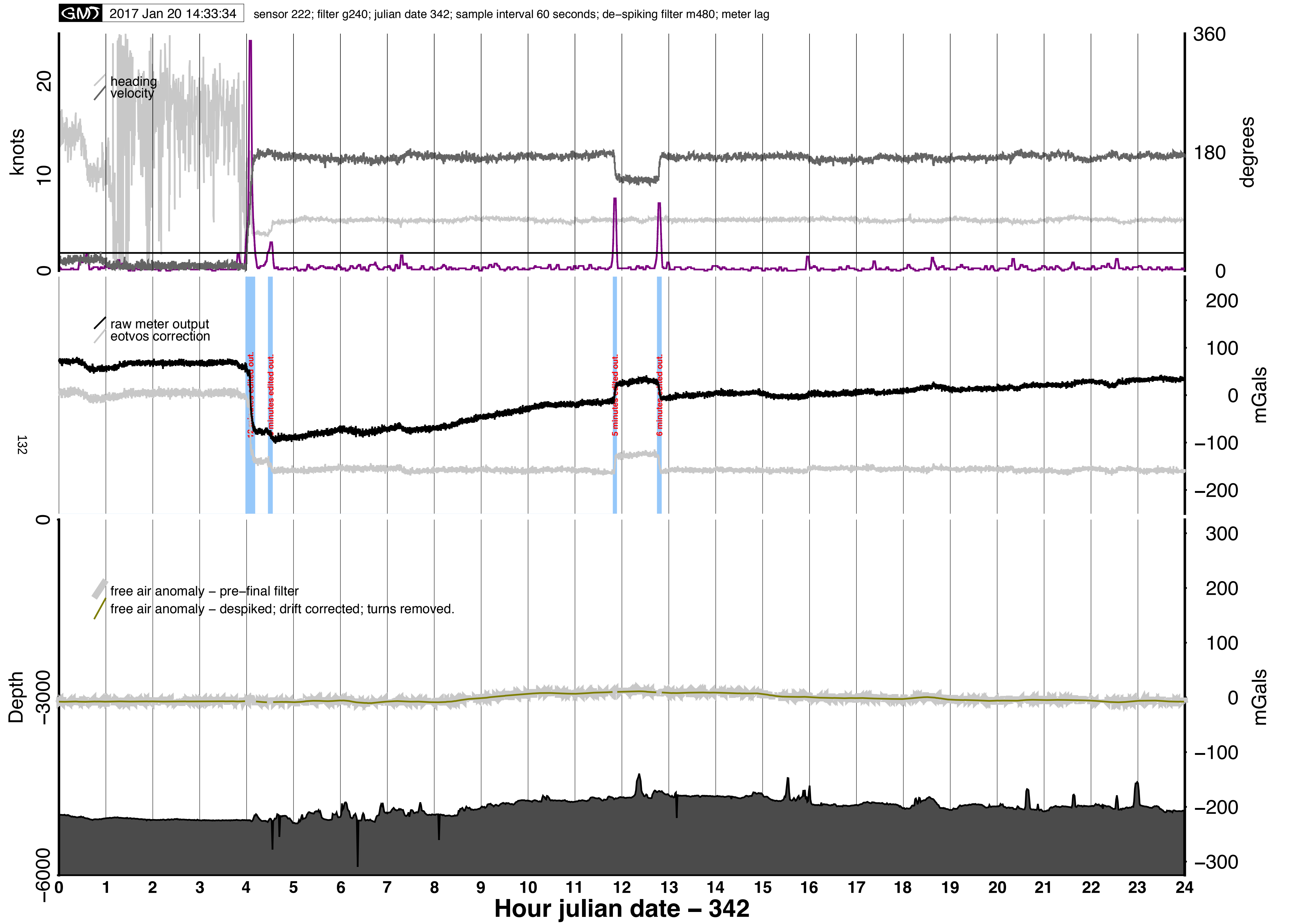

2017 Jan 20 14:32:40
sensor 222; filter g240; julian date 338; sample interval 60 seconds; de−spiking filter m480; meter lag
heading
velocity
knots
degrees
raw meter output
eotvos correction
mGals
7 minutes edited out.
3 minutes edited out.
4 minutes edited out.
2 minutes edited out.
6 minutes edited out.
free air anomaly – pre−final filter
free air anomaly – despiked; drift corrected; turns removed.
Depth
Hour julian date – 338

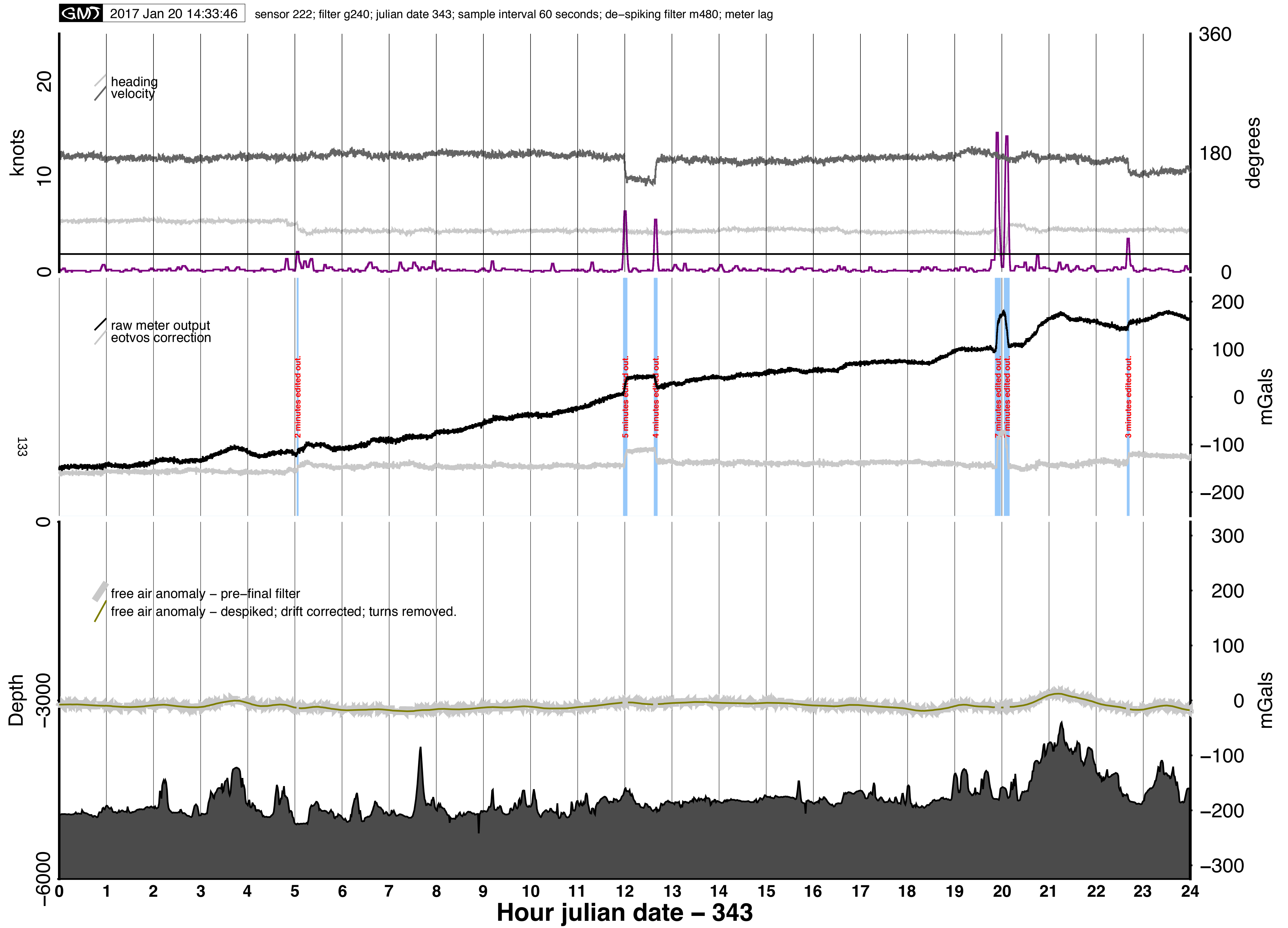


GMT 2017 Jan 20 14:32:56
sensor 222; filter g240; julian date 339; sample interval 60 seconds; de−spiking filter m480; meter lag
heading
velocity
knots
degrees
raw meter output
eotvos correction
mGals
free air anomaly − pre−final filter
free air anomaly − despiked; drift corrected; turns removed.
Depth
Hour julian date − 339

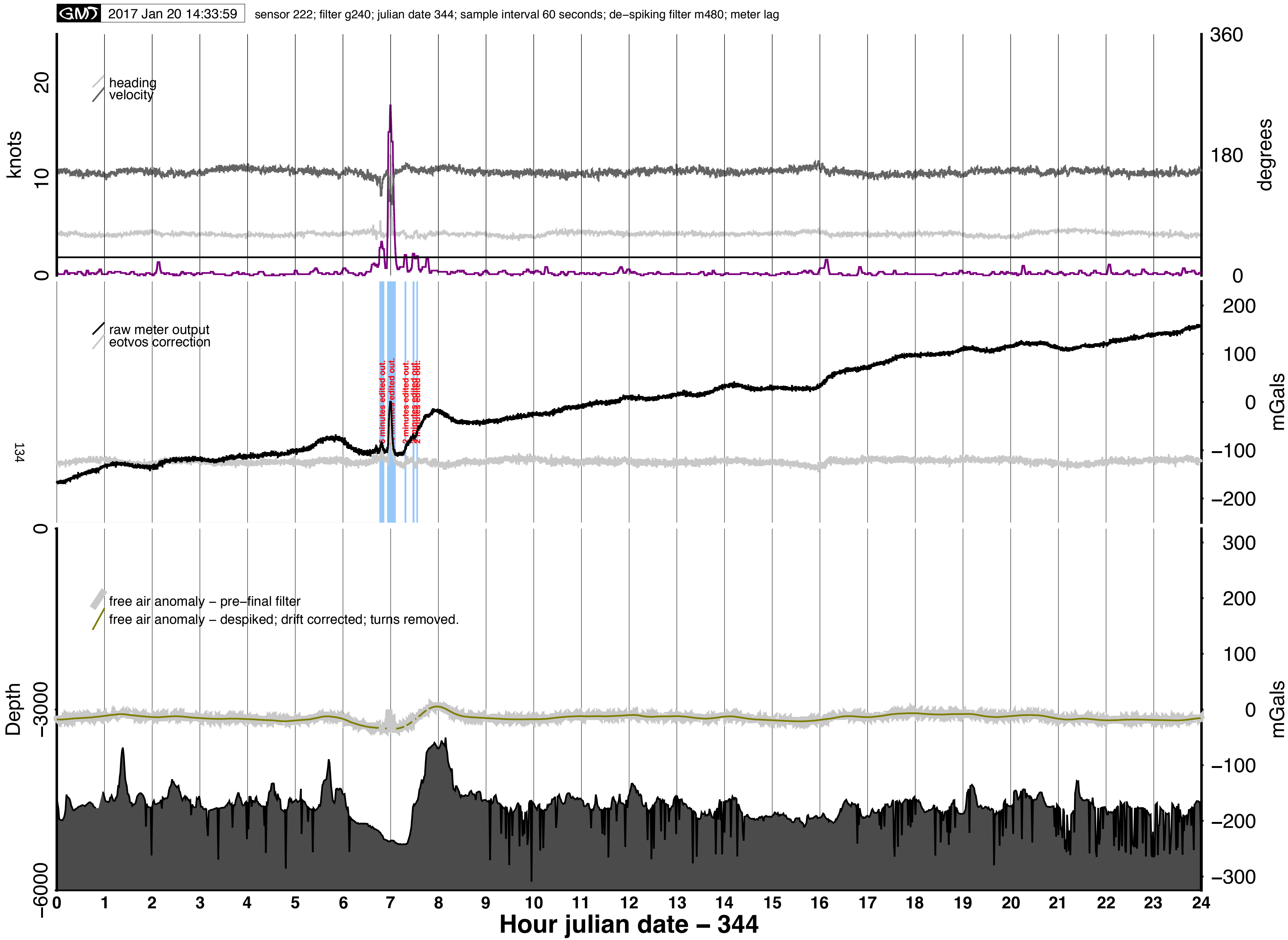

2017 Jan 20 14:33:09
sensor 222; filter g240; julian date 340; sample interval 60 seconds; de−spiking filter m480; meter lag
heading
velocity
knots
degrees
raw meter output
eotvos correction
mGals
free air anomaly – pre−final filter
free air anomaly – despiked; drift corrected; turns removed.
Depth
Hour julian date – 340


2017 Jan 20 14:33:21
sensor 222; filter g240; julian date 341; sample interval 60 seconds; de−spiking filter m480; meter lag
heading
velocity
knots
degrees
raw meter output
eotvos correction
mGals
free air anomaly – pre−final filter
free air anomaly – despiked; drift corrected; turns removed.
Depth
Hour julian date – 341

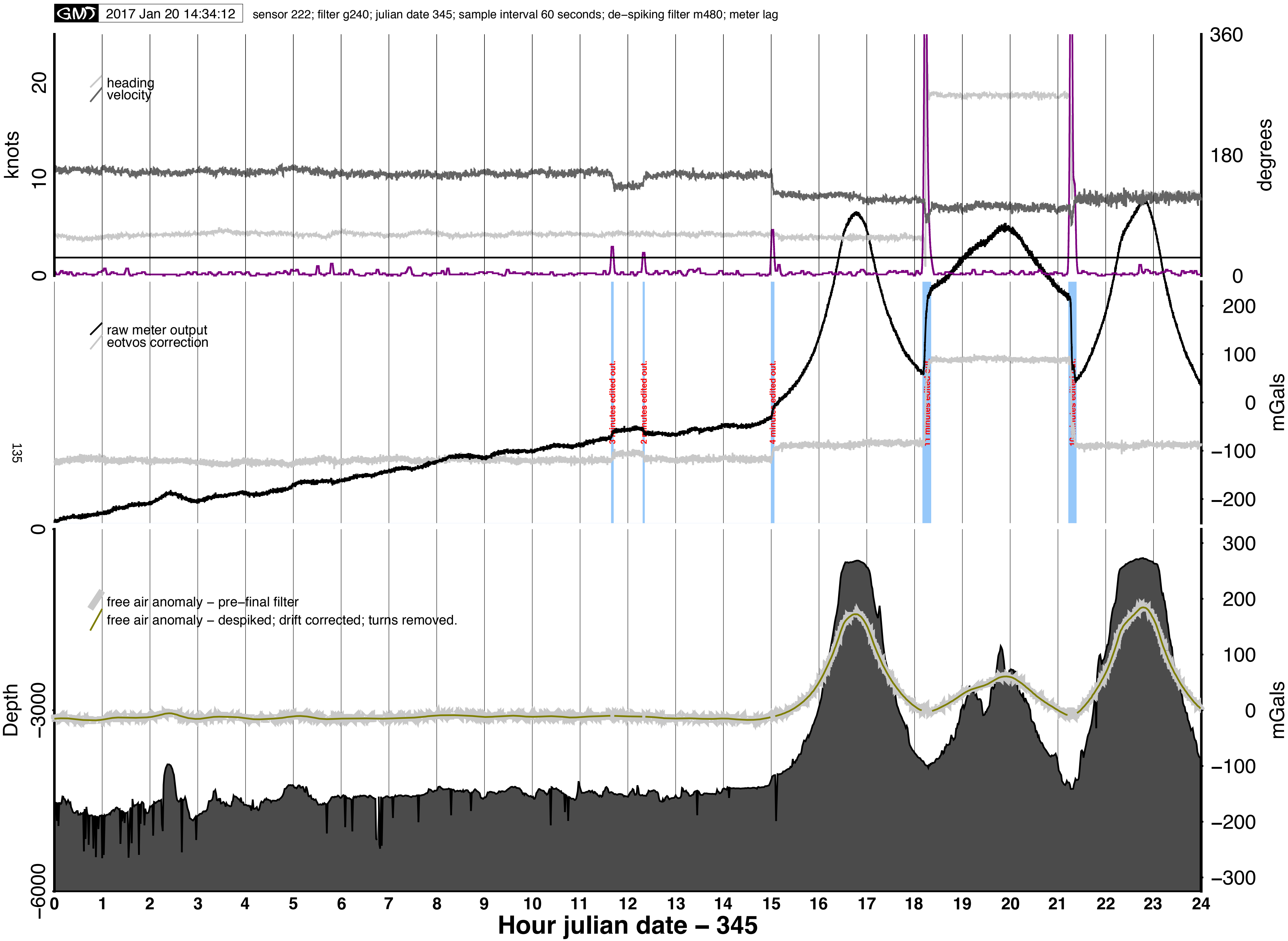

GMT 2017 Jan 20 14:33:34
sensor 222; filter g240; julian date 342; sample interval 60 seconds; de−spiking filter m480; meter lag
heading
velocity
knots
degrees
raw meter output
eotvos correction
mGals
5 minutes edited out.
6 minutes edited out.
free air anomaly − pre−final filter
free air anomaly − despiked; drift corrected; turns removed.
Depth
Hour julian date − 342



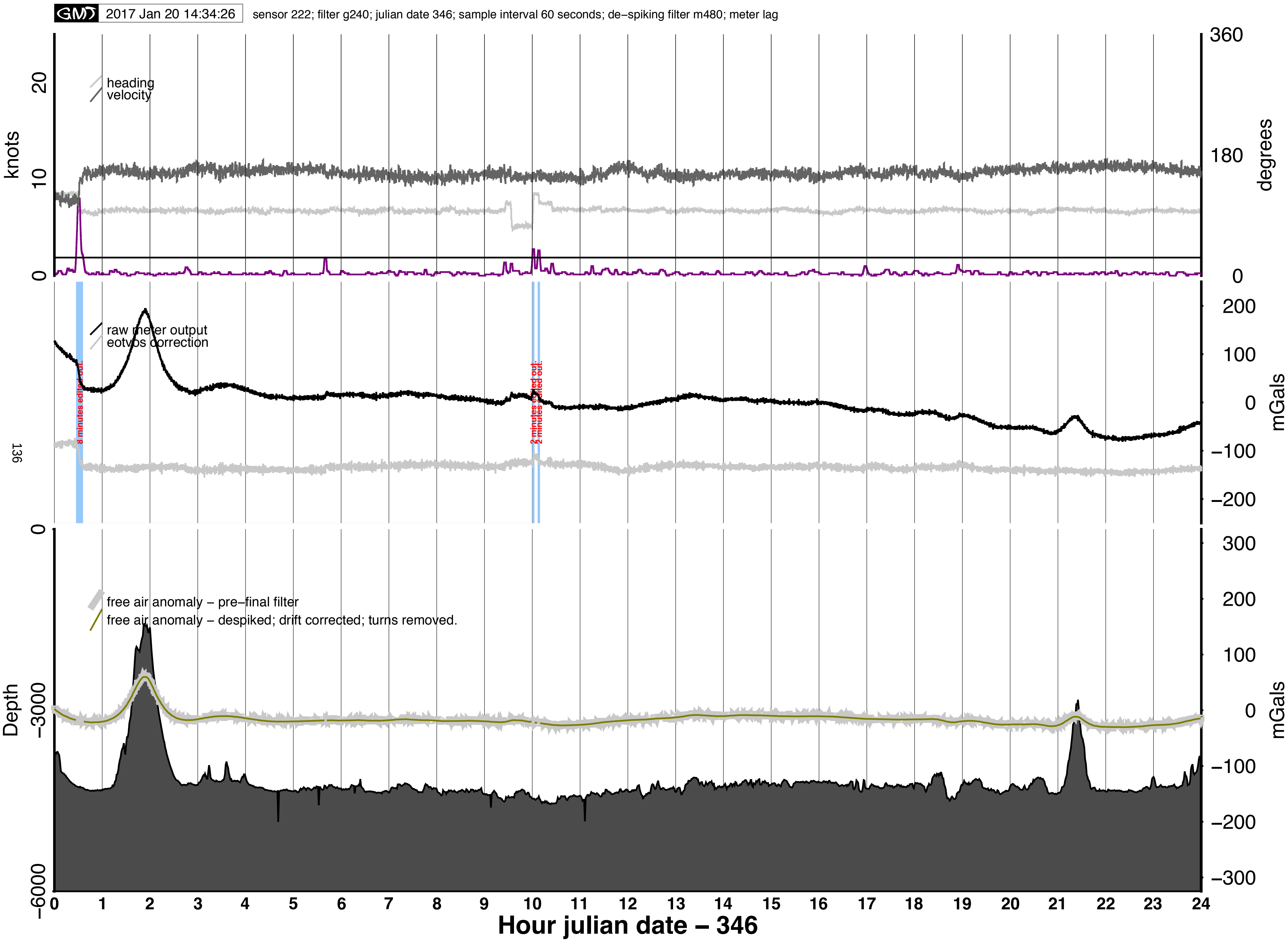
2017 Jan 20 14:33:46
sensor 222; filter g240; julian date 343; sample interval 60 seconds; de−spiking filter m480; meter lag
heading
velocity
knots
degrees
raw meter output
eotvos correction
2 minutes edited out.
5 minutes edited out.
4 minutes edited out.
7 minutes edited out.
7 minutes edited out.
3 minutes edited out.
mGals
free air anomaly – pre−final filter
free air anomaly – despiked; drift corrected; turns removed.
Depth
mGals
Hour julian date – 343



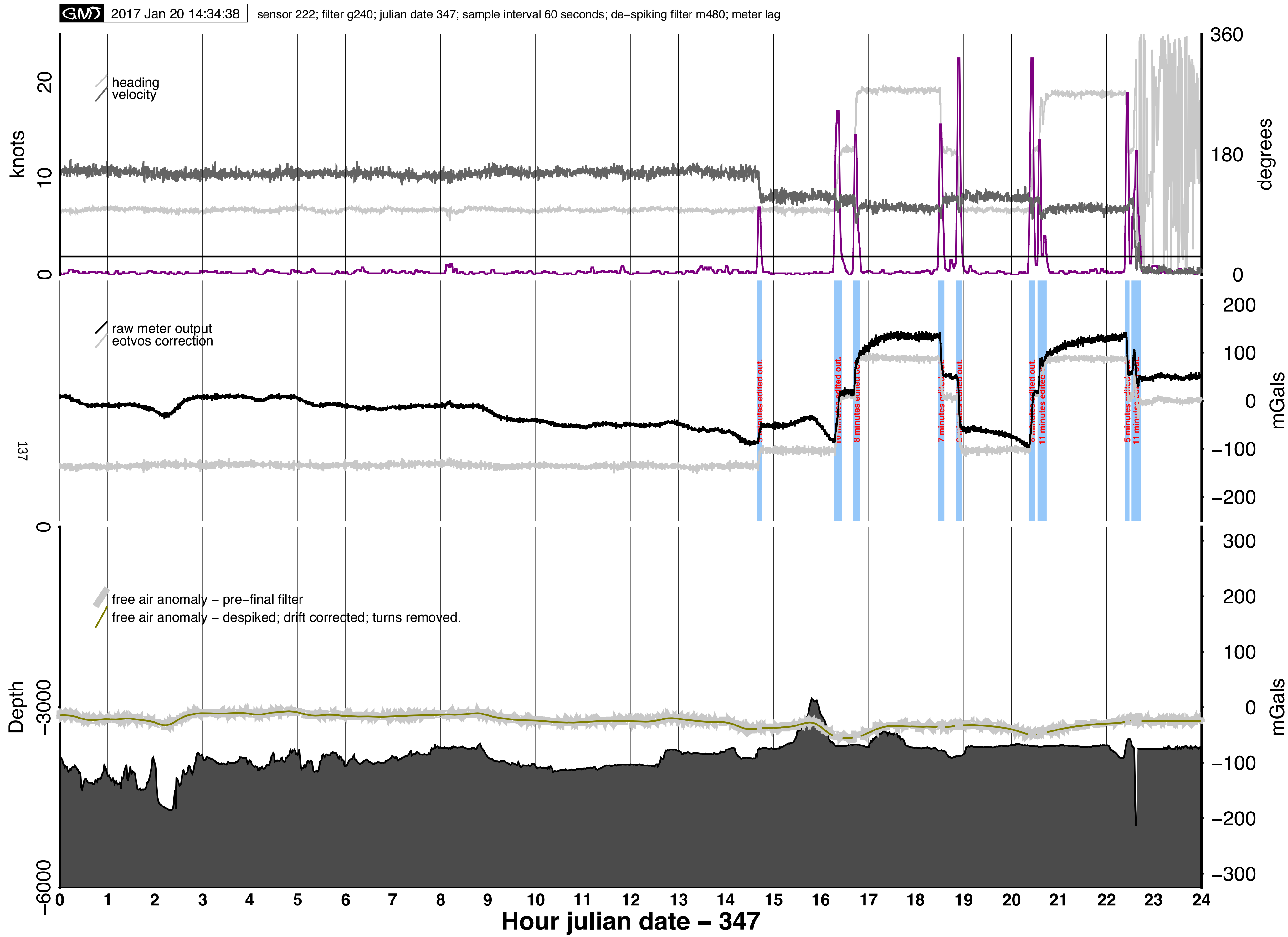
2017 Jan 20 14:33:59
sensor 222; filter g240; julian date 344; sample interval 60 seconds; de−spiking filter m480; meter lag
heading
velocity
knots
degrees
raw meter output
eotvos correction
6 minutes edited out.
2 minutes edited out.
mGals
free air anomaly − pre−final filter
free air anomaly − despiked; drift corrected; turns removed.
Depth
Hour julian date − 344

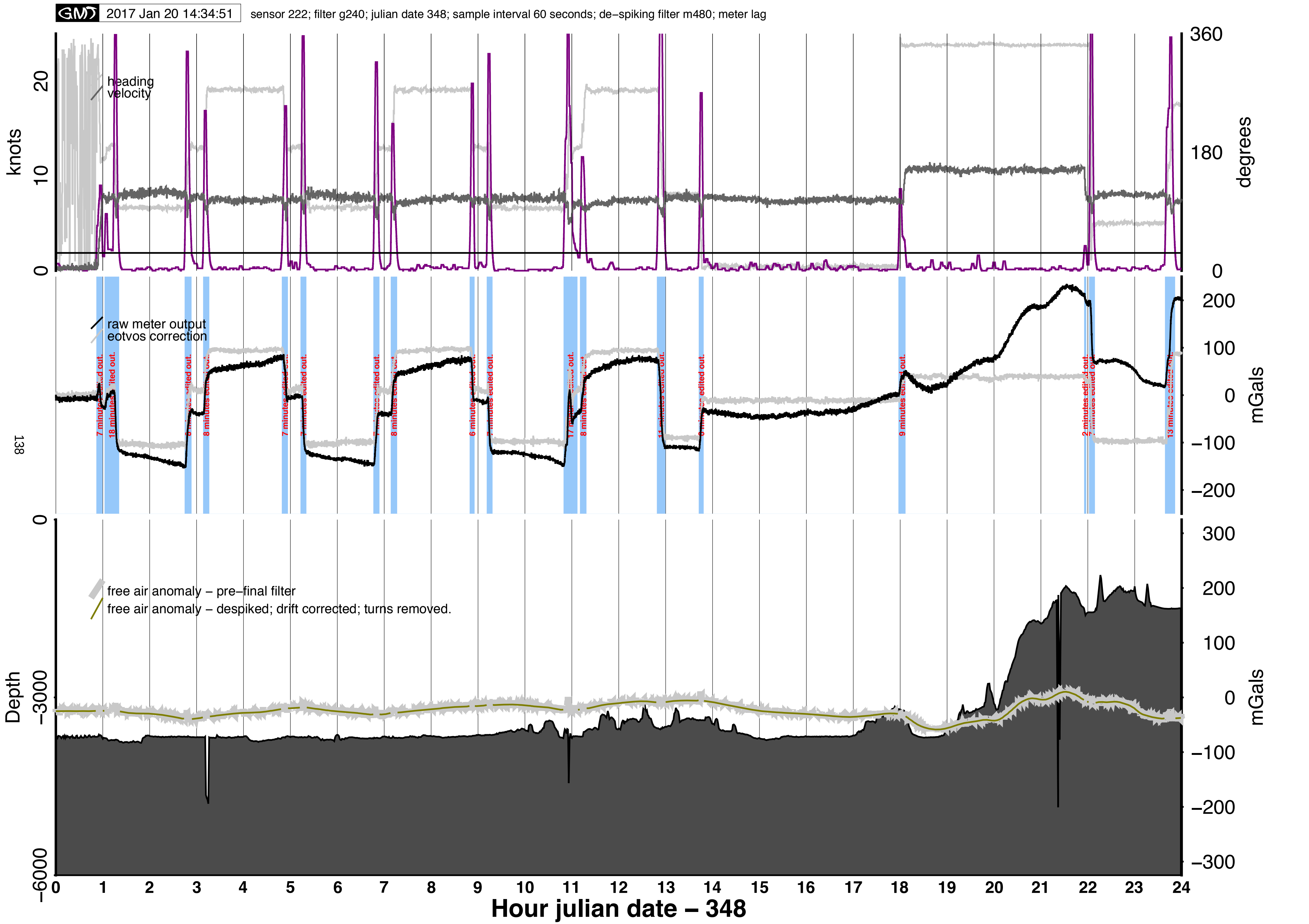


2017 Jan 20 14:34:12
sensor 222; filter g240; julian date 345; sample interval 60 seconds; de-spiking filter m480; meter lag
heading
velocity
knots
degrees
raw meter output
eotvos correction
mGals
3 minutes edited out.
2 minutes edited out.
4 minutes edited out.
free air anomaly – pre–final filter
free air anomaly – despiked; drift corrected; turns removed.
Depth
Hour julian date – 345

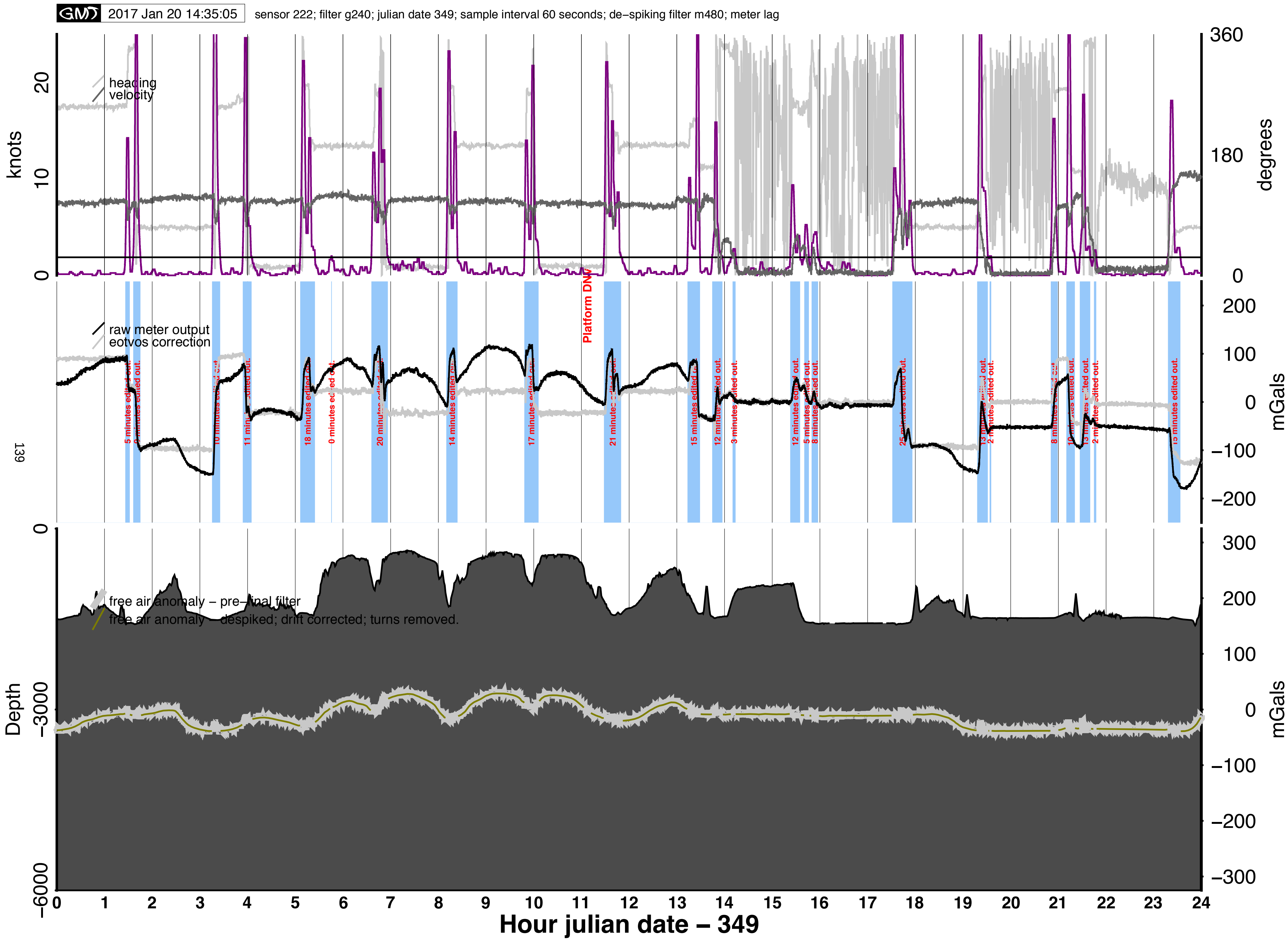


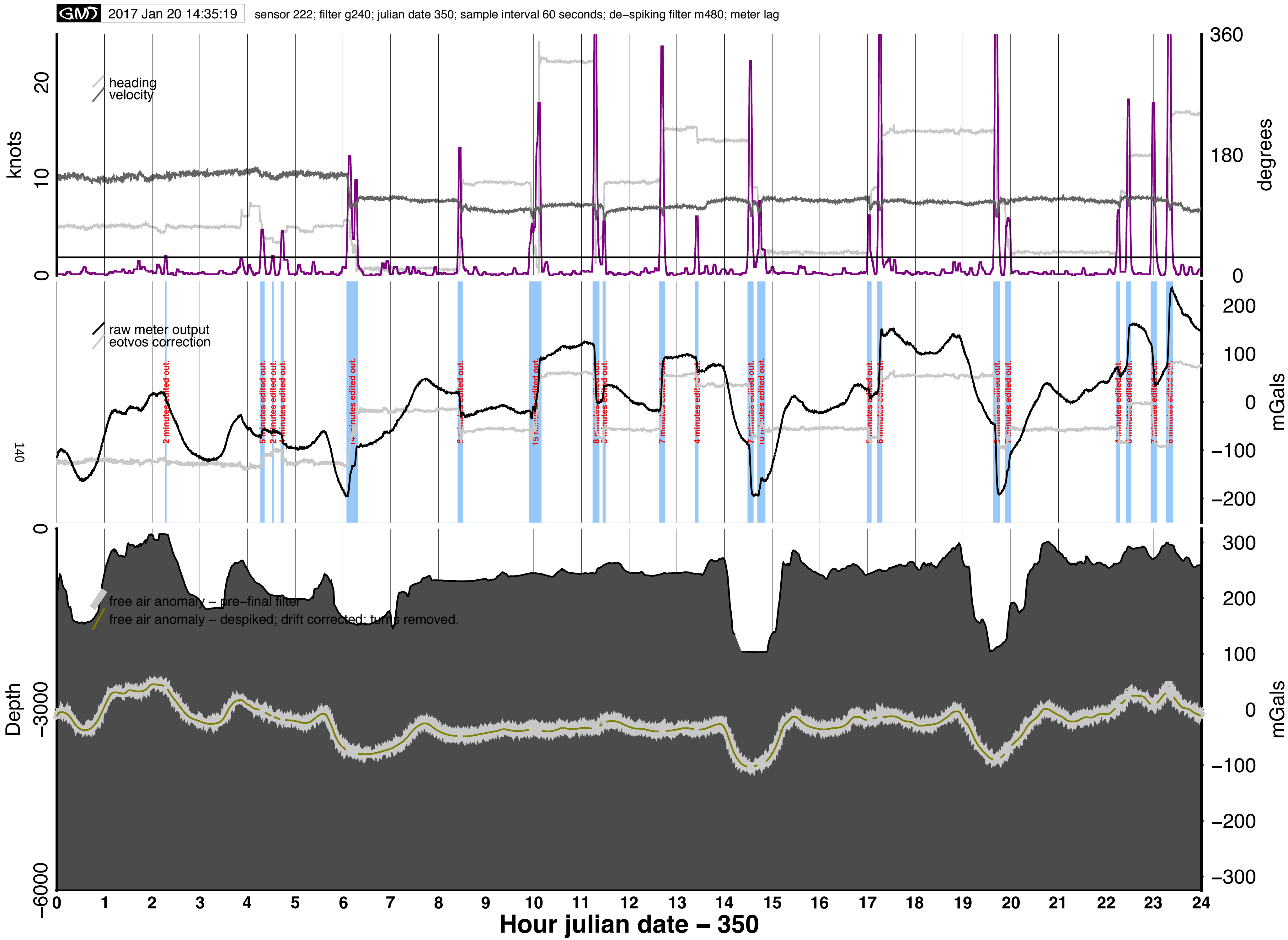
2017 Jan 20 14:34:26
sensor 222; filter g240; julian date 346; sample interval 60 seconds; de−spiking filter m480; meter lag
heading
velocity
knots
degrees
raw meter output
eotvos correction
8 minutes edited out.
2 minutes edited out.
2 minutes edited out.
mGals
free air anomaly − pre−final filter
free air anomaly − despiked; drift corrected; turns removed.
Depth
Hour julian date − 346


GMT 2017 Jan 20 14:34:38
sensor 222; filter g240; julian date 347; sample interval 60 seconds; de−spiking filter m480; meter lag
heading
velocity
knots
degrees
raw meter output
eotvos correction
mGals
free air anomaly − pre−final filter
free air anomaly − despiked; drift corrected; turns removed.
Depth
Hour julian date − 347

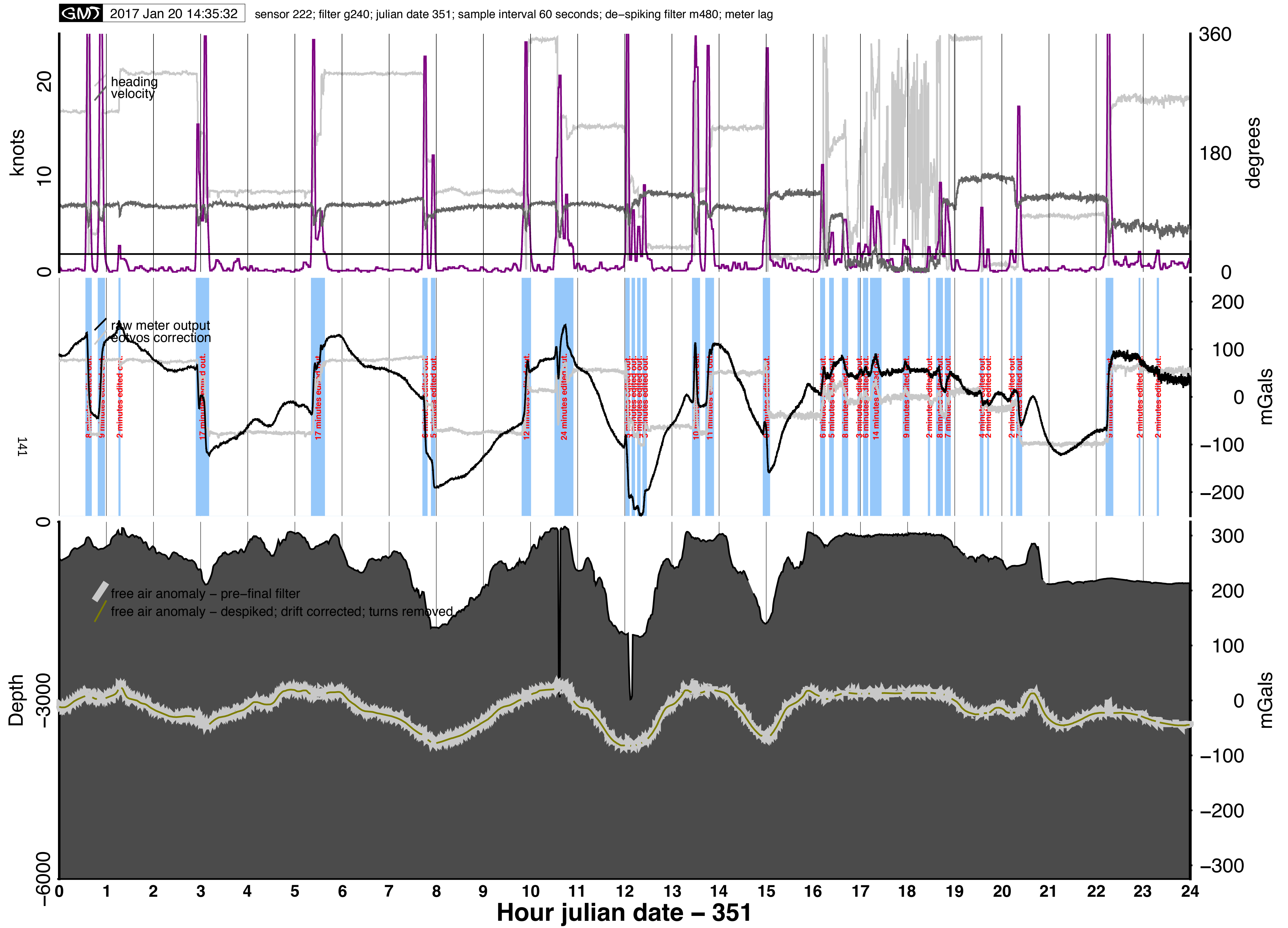


2017 Jan 20 14:34:51
sensor 222; filter g240; julian date 348; sample interval 60 seconds; de−spiking filter m480; meter lag
heading
velocity
knots
degrees
raw meter output
eotvos correction
mGals
free air anomaly − pre−final filter
free air anomaly − despiked; drift corrected; turns removed.
Depth
Hour julian date − 348

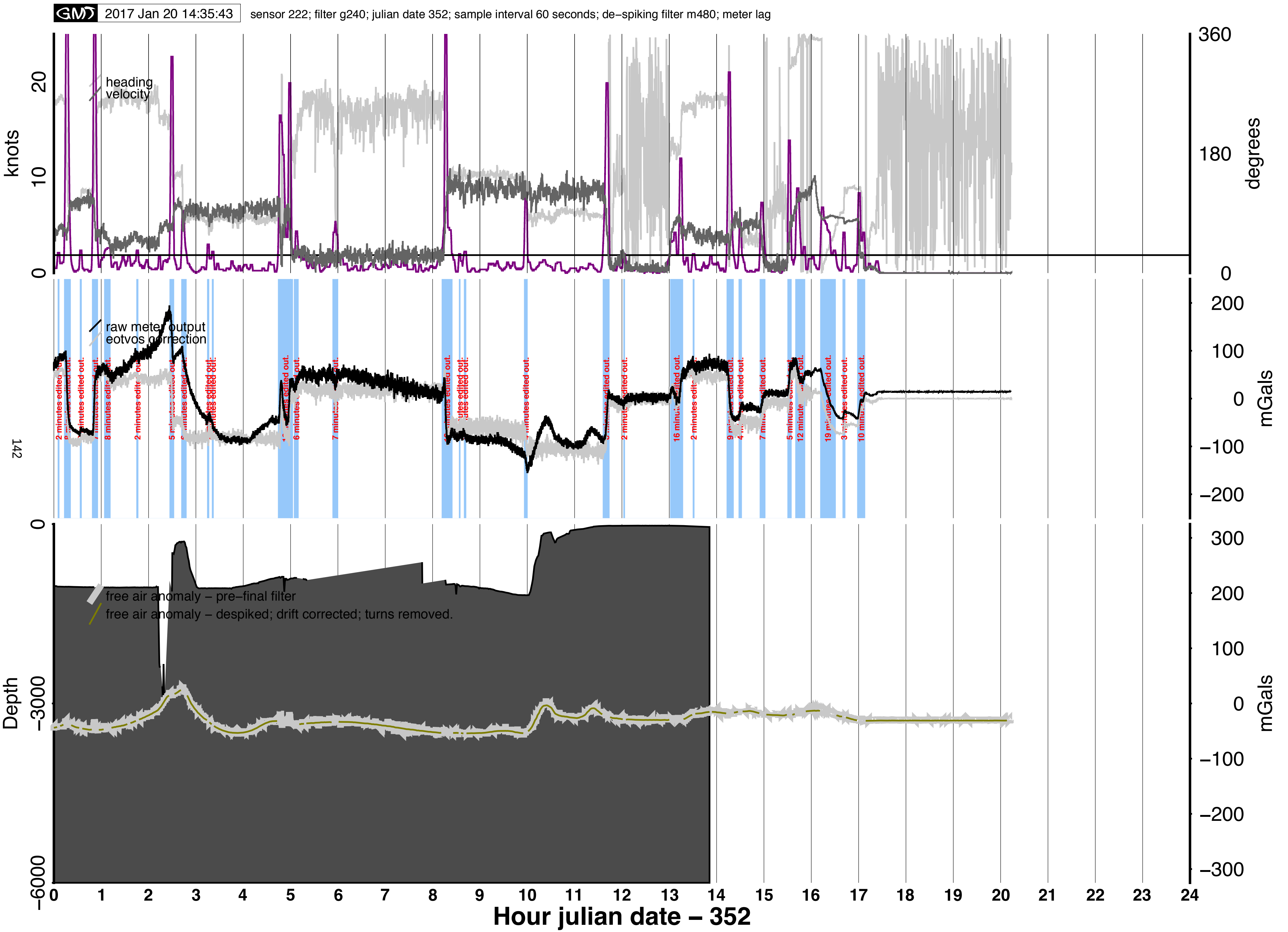

2017 Jan 20 14:35:05
sensor 222; filter g240; julian date 349; sample interval 60 seconds; de−spiking filter m480; meter lag
heading
velocity
knots
degrees
raw meter output
eotvos correction
Platform DNV
mGals
free air anomaly – pre−final filter
free air anomaly – despiked; drift corrected; turns removed.
Depth
mGals
Hour julian date – 349



2017 Jan 20 14:35:19
sensor 222; filter g240; julian date 350; sample interval 60 seconds; de−spiking filter m480; meter lag
heading
velocity
knots
degrees
raw meter output
eotvos correction
mGals
free air anomaly – pre−final filter
free air anomaly – despiked; drift corrected; turns removed.
Depth
Hour julian date – 350



2017 Jan 20 14:35:32
sensor 222; filter g240; julian date 351; sample interval 60 seconds; de−spiking filter m480; meter lag
knots
degrees
heading
velocity
raw meter output
eotvos correction
mGals
Depth
free air anomaly – pre−final filter
free air anomaly – despiked; drift corrected; turns removed
Hour julian date – 351



2017 Jan 20 14:35:43
sensor 222; filter g240; julian date 352; sample interval 60 seconds; de−spiking filter m480; meter lag
knots
degrees
heading
velocity
raw meter output
eotvos correction
mGals
Depth
free air anomaly − pre−final filter
free air anomaly − despiked; drift corrected; turns removed.
Hour julian date − 352

Appendix H - Coring Operations

Gyre Site – SKQ201616T

Latitude: ~~34° 57~~ 26°6.8164 N

Longitude: 144° 8.4857 W

Depth (meters): 5016

Geophysical Survey

Date (mo/day/yr) (GMT): 12/6/16

End Time (GMT):

Coring operations

Coring Tool	G1	G2	Additional Comments
Deployment #	1		
Date (mo/day/yr) (GMT)	12/6/16 ~~2319~~	12/6/16	
Time launched (GMT)	23:19	23 19	
Lat	26° 6.8100	26° 6.8100	
Lon	144° 8.3276	144 8.3276	
Depth (m)	4989	5056	
Date on bottom	12/6/16	12/6/16	
* Time on bottom (GMT)	01 26	01 45	
Lat	26° 5.7702	26° 5.8083	
Lon	144° 7.7986	144° 7.9196	
* Depth (m)	5038	5054	
Date recovered	12/6/16	12/6/16	
Time recovered (GMT)		03:23	
Lat		26°05.572	
Lon		144°08.546	
Depth (m)		5074	
Tension (lbs.)			
Surface	~400 - 500	450?	
Prior to Trip	~ 7,000	8000	
* On Bottom	~ 8600	8000	
* Pullout Max	10,000	8000	
Ascending	8000	8000	
Corer Length (cm)		100	
Total sediment recovered (cm)			
# of sections/# of tubes			
Weight on tool (lbs)			
* Payout speed	30 m/s (Tube 1) / 30m/s (Tube 2)	30 m/s	
Comments/Remarks/Log			
* Payout (m)	5100	5250m	

Additional Comments: Unsure if we hit the bottom - no pull out on a unsensitive winch.

Two drops potentially.

~~Gyre Site~~ – SKQ201616T – 02 (GHK seamount #1)

Latitude: 32°13.966 N
Longitude: 119°43.403 W
Depth (meters): 1000 m

Geophysical Survey

Date (mo/day/yr) (GMT): 12/14/16
End Time (GMT): 17:29

Coring operations

Coring Tool	G1 (top)	G2 (moat)	Additional Comments
Deployment #	1	2	
Date (mo/day/yr) (GMT)	12/14/16	〃	
Time launched (GMT)	14:17:32	16:06:00	
Lat	32° 13.982 N	32° 13.893'	
Lon	119° 43.402 W	119° 44.708'	
Depth (m)	1007 m	1572	
Date on bottom	12/14/16	12/14/16	
Time on bottom (GMT)	14:40:27	16:49:00	
Lat	32° 14.043' N	32° 13.957' N	
Lon	119° 43.431' W	119° 44.6646' W	
Depth (m)	941	1569	
Date recovered	12/14/16	12/14/16	
Time recovered (GMT)	15:16:54	17:29:28	
Lat	32° 14.041 N	32° 13.9163' N	
Lon	119° 43.465 W	119° 44.6609'	
Depth (m)	938	1569	
Tension (lbs.)			
Surface	50 lbs - could be low sensitivity of winch		should read ~3-400 lbs [illegible]
Prior to ~~Trip~~ Hit	1400	~~1400~~ 2000	
On Bottom	900	2000	
Pullout Max	1500 (no pullout)	2900	
Ascending	1400	2500	
Corer Length (cm)	~200cm	~200cm	
Total sediment recovered (cm)	N/A	133	
# of sections/# of tubes			
Weight on tool (lbs)	~300-400	~300-400	
Comments/Remarks/Log		[illegible]	

Payout speed – 30 m/min
Speed @ hit – 40 m/min
Payout (meters) – 939

payout - 60 m/min
Speed @ hit - [illegible] m/min
payout (m) - 1580.8 m
[illegible]

Site 3 ~~Gyre Site~~ – SKQ201616T

Latitude: 32° 17,1090 N
Longitude: 119° 32.1607 W
Depth (meters): 1488

Geophysical Survey

Date (mo/day/yr) (GMT): 12/14/16 19:35:16
End Time (GMT):

Coring operations

Coring Tool	G1 control/reference core	G2	Additional Comments
Deployment #	1		
Date (mo/day/yr) (GMT)	12/14/16		
Time launched (GMT)	19:35:16		
Lat	32° 17.2087 N		
Lon	119° 32.3627		
Depth (m)	1485		
Date on bottom	12/14/16		
Time on bottom (GMT)	2012		
Lat	32° 17.2082		
Lon	119° 32.3624		
Depth (m)	1480		
Date recovered	12/14/16		
Time recovered (GMT)	20:46		
Lat	32° 17.2083		
Lon	119° 3621		
Depth (m)	1484		
Tension (lbs.)			
Surface	30		
Prior to ~~Trip~~ Hit	2,000		
On Bottom	2,100		
Pullout Max	~2,400 @1470m		
Ascending	2350		
Corer Length (cm)	~200		
Total sediment recovered (cm)			
# of sections/# of tubes			
Weight on tool (lbs)	~300 -400		
Comments/Remarks/Log	Payout 1490 m		

payout speed (m/min) 30
speed @ h- (m/min) 40m/min
payout (m)

Gyre Site – SKQ201616T

Latitude: 32° 16.6240 N

Longitude: 119° 33.9491 W

Depth (meters): 1419

Geophysical Survey

Date (mo/day/yr) (GMT): 12/14/16 2201

End Time (GMT): 2309

Coring operations

Coring Tool	G1 HK4 core (mote)	G2	Additional Comments
Deployment #	1		
Date (mo/day/yr) (GMT)	12/14/16		
Time launched (GMT)	2201		
Lat	32° 166181		
Lon	119° 33.9453		
Depth (m)	1419		
Date on bottom	12/14/16		
Time on bottom (GMT)	2239		
Lat	32° 16.3646		
Lon	119° 33.7394		
Depth (m)	1475		
Date recovered	12/14/16		
Time recovered (GMT)	23:09		
Lat	32° 16.1687		
Lon	119° 33.4726		
Depth (m)	1487		
Tension (lbs.)			
Surface	~40 ?		
Prior to Trip (hit)	1800		
On Bottom	2000		
Pullout Max	2900		
Ascending	2300		
Corer Length (cm)			
Total sediment recovered (cm)			
# of sections/# of tubes			
Weight on tool (lbs)			
Comments/Remarks/Log	1485 m out 40 m/min		

site trying to hit
32° 39.0086 N
117° 57.2668 W
180-190 m

core 1

methane

~~Gyre Site~~ – SKQ201616T

Latitude: 32.65093 N
Longitude: 117.95456 W
Depth (meters): 221

Geophysical Survey

Date (mo/day/yr) (GMT): 12/16/16
End Time (GMT): 18:23

Coring operations

Coring Tool	G1	G2	Additional Comments
Deployment #	1	2	new site/core 2 32.650046 N 117.955101 W
Date (mo/day/yr) (GMT)	12/16/16	12/16/16	
Time launched (GMT)	17:26	18:04	
Lat	32.65189 N	32.651106 N	
Lon	117° .95437 W	117. 954033 W	
Depth (m)	219	192	
Date on bottom	12/16/16	12/16/16	
Time on bottom (GMT)	17:35	18:15	
Lat	32.650986N	32.651031 N	
Lon	117.952997 W	117.95402 W	
Depth (m)	203	191.6	
Date recovered	12/16/16	12/16/16	
Time recovered (GMT)	17:45	18:23	
Lat	32.6509578N	32.651104 N	
Lon	117.9522930W	117.954022 W	
Depth (m)	206 m	191.8 m	
Tension (lbs.)			
Surface	0	0	
Prior to ~~Trip~~ Hit	120	170	
On Bottom	0	0	
Pullout Max	300	272	
Ascending	200	170	
Corer Length (cm)	~200	~200	
Total sediment recovered (cm)			
# of sections/# of tubes			
Weight on tool (lbs)			
Comments/Remarks/Log	-first attempt drifted so we started again		

payout speed (m/min)	30	30
speed @ hit (m/min)	33	33
payout (m)	203.3m	198.1

Appendix I - Pre-Cruise Survey

Sikuliaq Pre-cruise Survey

A survey to assess a participants prior knowledge of research cruises and related proposal development.

A similar follow-up survey will be provided to assess the effectiveness of the future Chief Scientist training cruise.

Research Cruise Proposal Development

* 1. Rank your knowledge of the following topics related to "Proposal Development" on a scale of 0 (low) to 10 (high).

	0 - low	1	2	3	4	5	6	7	8	9	10 - high
Funding Agency to Approach	○	○	○	○	○	○	○	○	○	○	○
Hypothesis Testing vs Exploration	○	○	○	○	○	○	○	○	○	○	○
Data Availability & Location	○	○	○	○	○	○	○	○	○	○	○
Proposal Deadlines	○	○	○	○	○	○	○	○	○	○	○
Proposal Components	○	○	○	○	○	○	○	○	○	○	○
Project Summary	○	○	○	○	○	○	○	○	○	○	○
Intellectual Merit	○	○	○	○	○	○	○	○	○	○	○
Broader Impacts	○	○	○	○	○	○	○	○	○	○	○
Budget & Justification	○	○	○	○	○	○	○	○	○	○	○
Biosketch	○	○	○	○	○	○	○	○	○	○	○
Data Management Plan	○	○	○	○	○	○	○	○	○	○	○
Shiptime Request	○	○	○	○	○	○	○	○	○	○	○

Sikuliaq Pre-cruise Survey

A survey to assess a participants prior knowledge of research cruises and related proposal development.

A similar follow-up survey will be provided to assess the effectiveness of the future Chief Scientist training cruise.

Cruise-related Activities

* 2. Rank your knowledge of the following topics related to "Pre-cruise Activities" on a scale of 0 (low) to 10 (high).

	0 - low	1	2	3	4	5	6	7	8	9	10 - high
Communication with Ship Operator	○	○	○	○	○	○	○	○	○	○	○
Shipping	○	○	○	○	○	○	○	○	○	○	○
Travel Logistics	○	○	○	○	○	○	○	○	○	○	○

* 3. Rank your knowledge of the following topics related to "Cruise Activities" on a scale of 0 (low) to 10 (high).

	0 - low	1	2	3	4	5	6	7	8	9	10 - high
Ship’s Capabilities	○	○	○	○	○	○	○	○	○	○	○
Onboard Equipment	○	○	○	○	○	○	○	○	○	○	○
Pooled Equipment	○	○	○	○	○	○	○	○	○	○	○
Data Systems	○	○	○	○	○	○	○	○	○	○	○
Data Archival	○	○	○	○	○	○	○	○	○	○	○
Cruise Report	○	○	○	○	○	○	○	○	○	○	○

* 4. Rank your knowledge of the following topics related to "Post-Cruise Activities" on a scale of 0 (low) to 10 (high).

	0 - low	1	2	3	4	5	6	7	8	9	10 - high
Cruise Assessment	○	○	○	○	○	○	○	○	○	○	○
Archival of Derived Data	○	○	○	○	○	○	○	○	○	○	○
Publications	○	○	○	○	○	○	○	○	○	○	○

5. What are one or two anticipated outcomes that you have for participating in the Chief Scientist training cruise?

Sikuliaq Pre-cruise Survey

A survey to assess a participants prior knowledge of research cruises and related proposal development.

A similar follow-up survey will be provided to assess the effectiveness of the future Chief Scientist training cruise.

Demographics

* 6. Gender

- ◯ Female
- ◯ Male
- ◯ Other
- ◯ No Response

* 7. Education Level

- ◯ < 3 years graduate school
- ◯ > 3 years graduate school
- ◯ Post-Doctoral Researcher or Equivalent
- ◯ Assistant Professor or Equivalent
- ◯ Other

* 8. Number of prior research cruises of at least 5 days.

- ◯ 0
- ◯ 1-2
- ◯ 3-5
- ◯ > 5

* 9. What is the likelihood of submitting a research cruise proposal within the next year.

- ◯ Not Likely (0% chance)
- ◯ Possibly (25% chance)
- ◯ Likely (50% chance)
- ◯ Very Likely (75% chance)
- ◯ Definitely (100% chance)

* 10. What is the likelihood of submitting a research cruise proposal within the next 3 to 5 years.

- ◯ Not Likely (0% chance)
- ◯ Possibly (25% chance)
- ◯ Likely (50% chance)
- ◯ Very Likely (75% chance)
- ◯ Definitely (100% chance)

Appendix J - Post-Cruise Survey

Sikuliaq Post-cruise Survey.
A survey to assess a participants change in knowledge of research cruises and related proposal development.

Research Cruise Proposal Development

* 1. Rank your knowledge of the following topics related to "Proposal Development" on a scale of 0 (low) to 10 (high).

	0 - low	1	2	3	4	5	6	7	8	9	10 - high
Funding Agency to Approach	○	○	○	○	○	○	○	○	○	○	○
Hypothesis Testing vs Exploration	○	○	○	○	○	○	○	○	○	○	○
Data Availability & Location	○	○	○	○	○	○	○	○	○	○	○
Proposal Deadlines	○	○	○	○	○	○	○	○	○	○	○
Proposal Components	○	○	○	○	○	○	○	○	○	○	○
Project Summary	○	○	○	○	○	○	○	○	○	○	○
Intellectual Merit	○	○	○	○	○	○	○	○	○	○	○
Broader Impacts	○	○	○	○	○	○	○	○	○	○	○
Budget & Justification	○	○	○	○	○	○	○	○	○	○	○
Biosketch	○	○	○	○	○	○	○	○	○	○	○
Data Management Plan	○	○	○	○	○	○	○	○	○	○	○
Shiptime Request	○	○	○	○	○	○	○	○	○	○	○

Sikuliaq Post-cruise Survey.
A survey to assess a participants change in knowledge of research cruises and related proposal development.

Cruise-related Activities

* 2. Rank your knowledge of the following topics related to "Pre-cruise Activities" on a scale of 0 (low) to 10 (high).

	0 - low	1	2	3	4	5	6	7	8	9	10 - high
Communication with Ship Operator	○	○	○	○	○	○	○	○	○	○	○
Shipping	○	○	○	○	○	○	○	○	○	○	○
Travel Logistics	○	○	○	○	○	○	○	○	○	○	○

* 3. Rank your knowledge of the following topics related to "Cruise Activities" on a scale of 0 (low) to 10 (high).

	0 - low	1	2	3	4	5	6	7	8	9	10 - high
Ship's Capabilities	○	○	○	○	○	○	○	○	○	○	○
Onboard Equipment	○	○	○	○	○	○	○	○	○	○	○
Pooled Equipment	○	○	○	○	○	○	○	○	○	○	○
Data Systems	○	○	○	○	○	○	○	○	○	○	○
Data Archival	○	○	○	○	○	○	○	○	○	○	○
Cruise Report	○	○	○	○	○	○	○	○	○	○	○

* 4. Rank your knowledge of the following topics related to "Post-Cruise Activities" on a scale of 0 (low) to 10 (high).

	0 - low	1	2	3	4	5	6	7	8	9	10 - high
Cruise Assessment	○	○	○	○	○	○	○	○	○	○	○
Archival of Derived Data	○	○	○	○	○	○	○	○	○	○	○
Publications	○	○	○	○	○	○	○	○	○	○	○

5. What were your anticipated outcomes by participating in the Chief Scientist training cruise?

6. Do you feel you achieved your anticipated outcomes during the Chief Scientist training cruise?

Sikuliaq Post-cruise Survey.
A survey to assess a participants change in knowledge of research cruises and related proposal development.

Future Cruise Proposal Activities

* 7. What is the likelihood of submitting a research cruise proposal within the next year.

- Not Likely (0% chance)
- Possibly (25% chance)
- Likely (50% chance)
- Very Likely (75% chance)
- Definitely (100% chance)

* 8. What is the likelihood of submitting a research cruise proposal within the next 3 to 5 years.

- Not Likely (0% chance)
- Possibly (25% chance)
- Likely (50% chance)
- Very Likely (75% chance)
- Definitely (100% chance)

Sikuliaq Post-cruise Survey.
A survey to assess a participants change in knowledge of research cruises and related proposal development.

Overall Assessment

9. Did you feel the lectures/activities prior to the cruise were useful/helpful to prepare you for the cruise? Please comment on what you liked and what you thought could be better.

10. Did you feel the presentations after lunch during the cruise were useful/helpful for understanding shipboard operations and requirements for successful ocean-going proposals/projects?
Please comment on what you liked and what you thought could be better.

11. Did you feel the watchstanding activities were useful/helpful for understanding shipboard operations and requirements for successful ocean-going proposals/projects?
Please comment on what you liked and what you thought could be better.

12. On a professional level, what are 2 things that you think will be the most important result of your participation in this cruise 5 years from now.

13. On a personal level, what are 2 things that you think will be the most important result of your participation in this cruise 5 years from now.

14. Please provide any further comments on what you liked, disliked, or thought could be done better to make this training cruise a success.

15. If you were a tree, what kind of tree would you be?

Appendix K - Participant Survey Results

Pre- and Post-cruise Participant Survey Results.

Pre-cruise and post-cruise surveys were given to participants in the NSF-funded Marine Geology & Geophysics Chief Scientist Training Cruise to assess the effectiveness of the experience and to provide feedback on the various pre-cruise and cruise activities engaged in during a transit from Honolulu, HI to San Diego, CA.
aboard the *RV Sikuliaq* from Dec. 2 to Dec. 17, 2016.

The pre-cruise surveys were taken on November 29th, 2016 at the beginning of two days of classroom meetings at the Hawaii Institute of Geophysics. The post-cruise surveys were taken between Dec. 16th and Dec. 20th. There were 22 participants in the cruise (12 female, 10 male), but only 21 of 22 participants completed the surveys. The surveys were designed to be anonymous, but demographic information on the pre-cruise survey could possibly identify individual responses. We purposely avoided questions on the post-cruise survey that would allow the identification of any individuals responses. The pre- and post-cruise surveys are provided at the end of this section.

Overall, the comparison of pre-cruise and post-cruise survey responses indicate a very positive experience for participants.

The general topics pertaining to the duties of a chief scientist (e.g., Proposal Development, Pre-cruise Activities, Cruise Activities, and Post-cruise Activities) exhibit an increase in participant knowedge/confidence from initial ratings of 2-3 to final ratings of 7-8 on a rating scale of 0 – 10 with 10 being the highest rating.

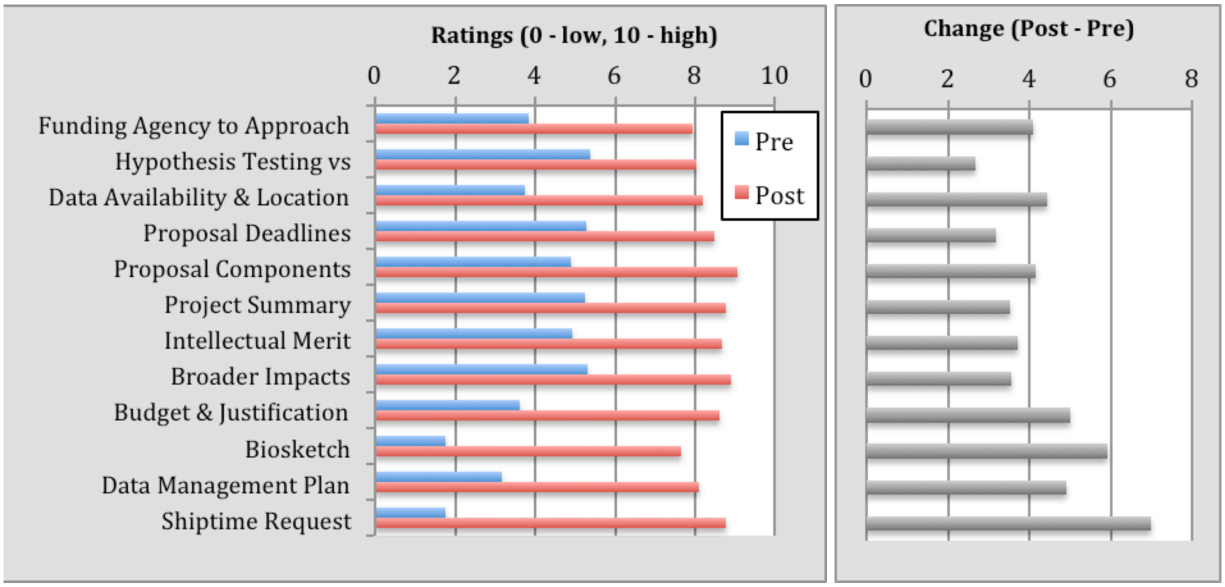
The impact of the training cruise on the likelihood of participants submitting proposals with ship time requests was a little disappointing, but this may not really be a surprise since the majority of the participants (16 of 22) are still graduate students. The likelihood of participants submitting proposals with ship requests within the next year increased from 24% to 28%. The likelihood for proposal submission with ship requests within the next 3-5 years increased from 52% to 55%.

Participants were asked what their anticipated outcomes for the training cruise on both the pre-cruise and post-cruise surveys. The typical response generally included gaining knowledge about the process of planning, writing, and executing proposals involving shipboard science. All responding participants very strongly indicated that their anticipated outcomes were realized.

Pre-cruise classroom presentations/activities and onboard, lunch-time presentations also received strong endorsements with positive and mostly positive responses.

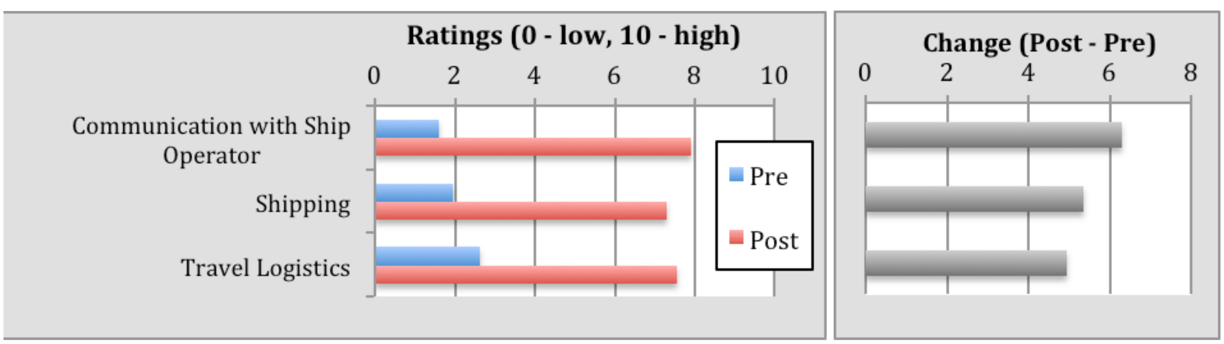
Participants were also asked to look down the road 5 years from now and think about the about the most important Professional and Personal outcomes they foresee from participating in the training cruise. For Professional Outcomes, the general responses included confidence in proposal writing, networking, working with the ship's crew, and knowledge of ship's science capabilities. For Personal Outcomes, the general responses included gaining respect for ship's crew, making connections with shipmates, working with others, and gaining confidence to request ship time.

1. **Rank your knowledge of the following topics related to "Proposal Development" on a scale of 0 (low) to 10 (high).**



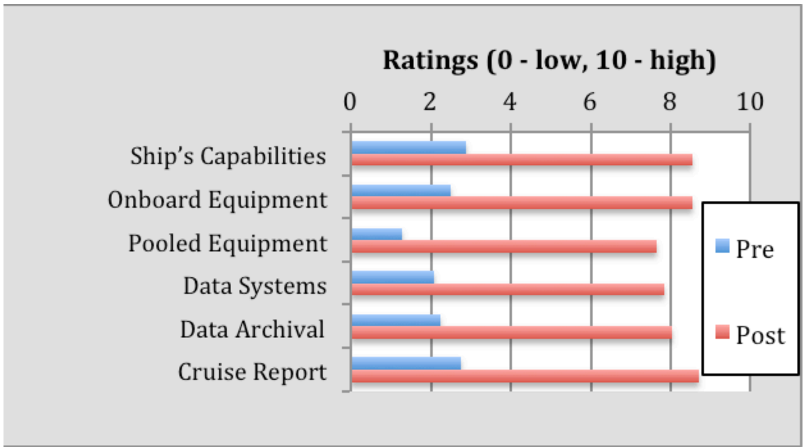
Min. Change: Hypothesis Testing vs Exploration (2.7)
Max. Change: Shiptime Request (7.0)
Mean Change: 4.4

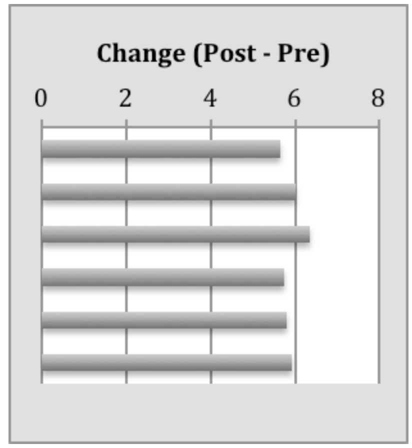
2. **Rank your knowledge of the following topics related to "Pre-cruise Activities" on a scale of 0 (low) to 10 (high).**



Min. Change: Travel Logistics (4.9)
Max. Change: Communication with Ship Operator (6.3)
Mean Change: 5.5

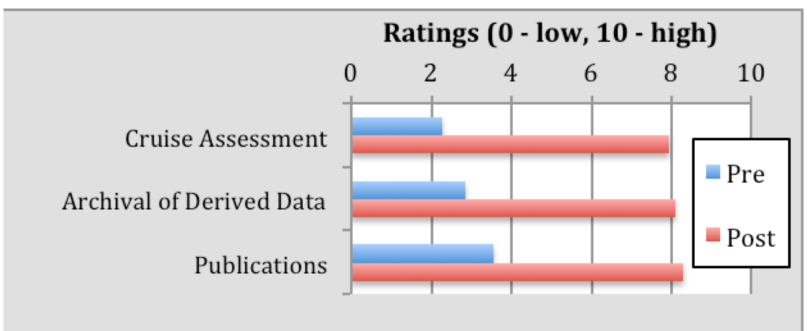
3. **Rank your knowledge of the following topics related to "Cruise Activities" on a scale of 0 (low) to 10 (high).**

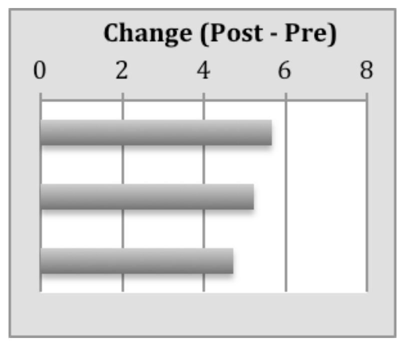




Min. Change: Ship's Capabilities (5.7)
Max. Change: Pooled Equipment (6.4)
Mean Change: 5.9

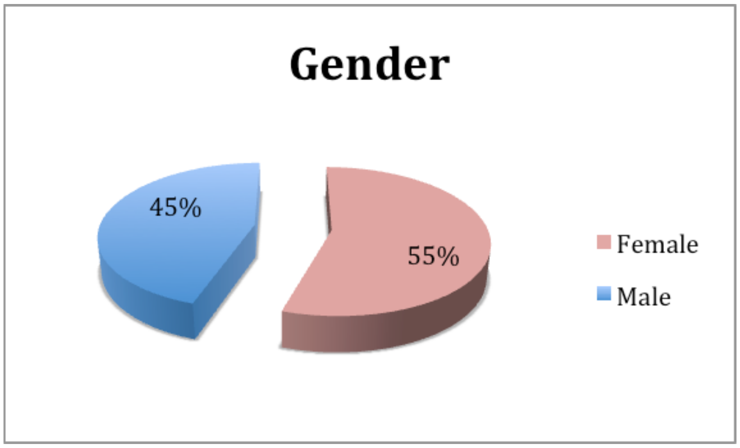
4. Rank your knowledge of the following topics related to "Post-Cruise Activities" on a scale of 0 (low) to 10 (high).



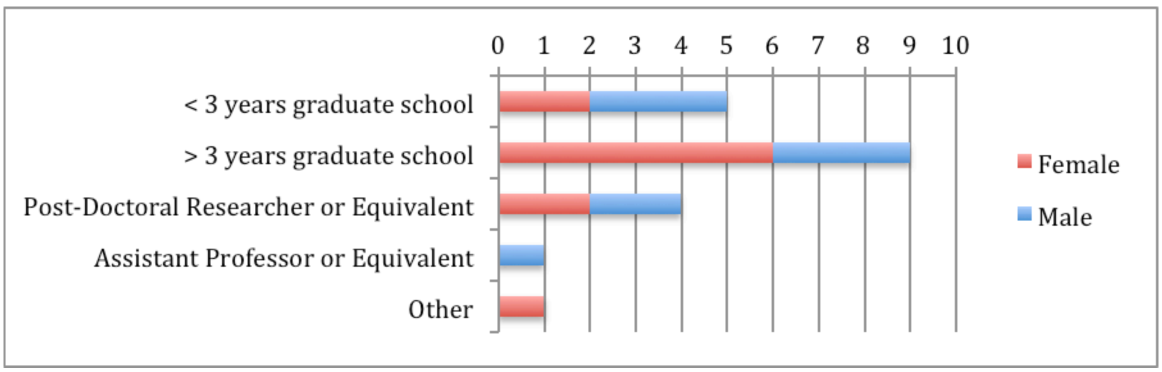


Min. Change: Publications (4.7)
Max. Change: Cruise Assessment (5.7)
Mean Change: 5.2

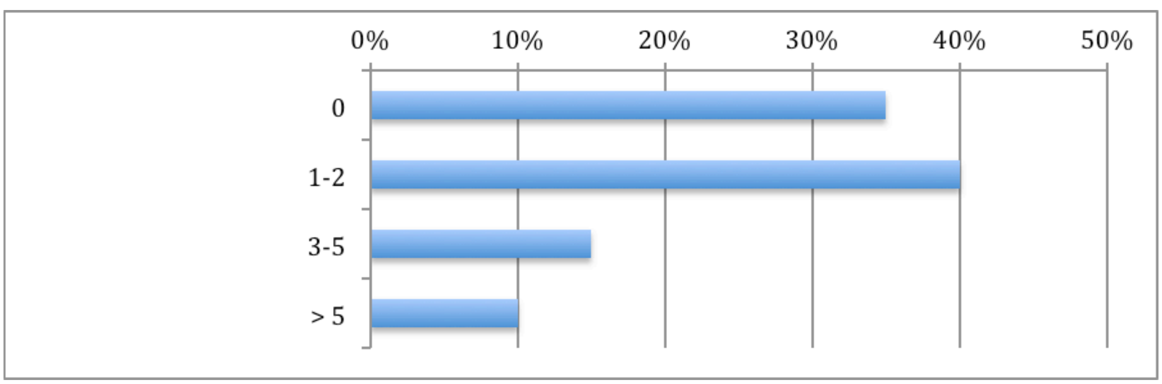
5. Gender



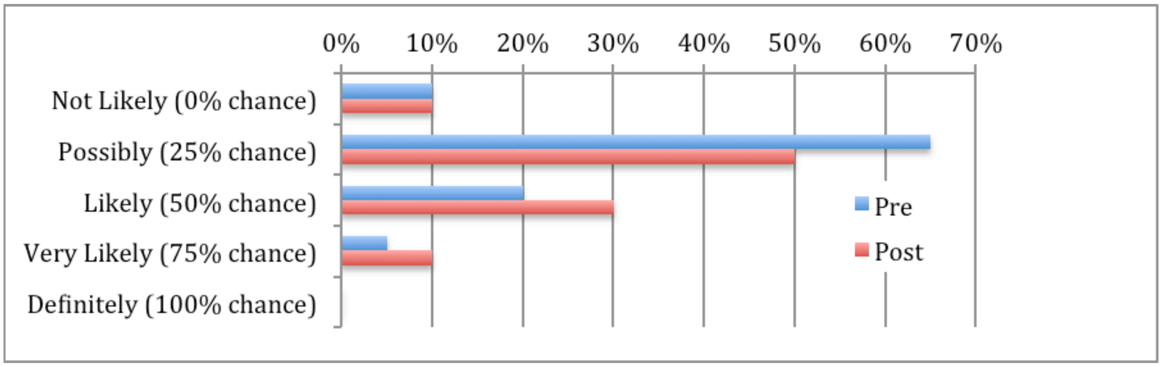
6. Education Level as a Function of Gender



7. Number of prior research cruises of at least 5 days.

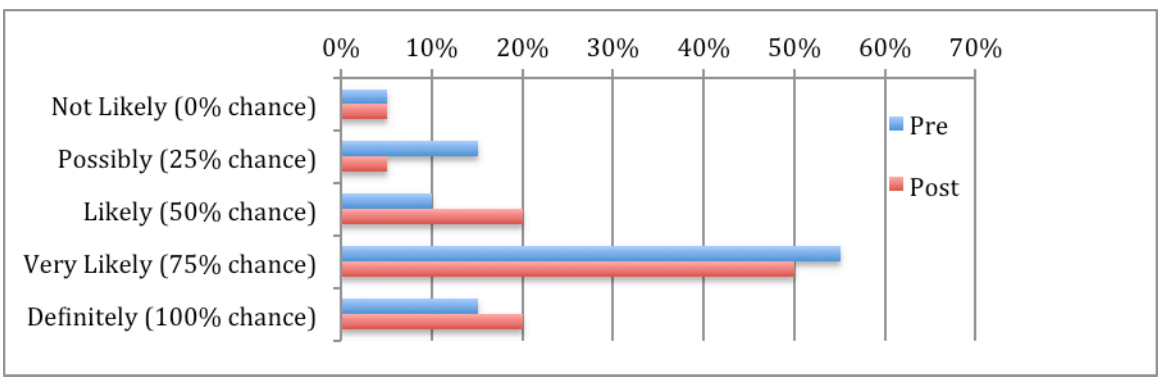


8. What is the likelihood of submitting a research cruise proposal within the next year.



Weighted Mean: Pre (24%), Post (28%)
3 Possibly => 2 Likely, 1 Very Likely

9. What is the likelihood of submitting a research cruise proposal within the next 3 to 5 years.



Weighted Mean: Pre (52%), Post (55%)
2 Possibly => 2 Likely,
1 Very Likely => Definitely

10. What are one or two anticipated outcomes that you have for participating in the Chief Scientist training cruise? (Pre-cruise)

1. Gain knowledge on writing proposals; learn how to use ship as a tool; how to use various equipment to get data.
2. Becoming familiar with the equipment available for use and the research capabilities of the RV Sikuliaq. Learning about proposal writing for ship research.
3. Learn how to effectively write a proposal and learn how to utilize shipboard equipment
4. Become familiar with utilizing research vessels as tools for geoscience research. Utilize modern techniques to gain insight into ancient environments.
5. Learning how to write effective proposals. Understanding how to better communicate with the crew and captain
6. Better understand d equipment t and how to use it.
7. I anticipate improved proposal writing and cruise planning skills for different vessels, and a better understanding of incorporating other science into said cruises.
8. Gain experience at writing coherently and concisely.
9. Get experience with NSF proposal writing, and if possible, image Spiess seamount chain using existing equipment on the ship.
10. Gain sea/oceanographic sampling experience. Understand how to utilize ship equipment to it's fullest extent.
11. Learn how to communicate effectively with scientists and crew. Learn about proposal writing.
12. Become more familiar with the cruise planning process. Become more familiar with different types of equipment used for ship-related research.
13. I really want to know what it's like to work on a research vessel, as I am transitioning my career focused on marine science and have no previous experience on research vessels. I also hope to broaden the survey of microbial communities in surface sediments of the ocean by collecting core samples that may provide useful data for a future proposal.
14. To gain familiarity with the process of planning, writing, and executing proposals involving shipboard science.
15. How to communicate with crew on planning to get data and getting data, archiving data. Making the best of the situation and being flexible in working with the ship and circumstances.
16. The ability to write a proposal, and an understanding of ship capabilities and limitations
17. Gain better understanding of effective utilization of ship time, i.e. best odds for funding based on specific ship, its location and schedule, etc.
18. Become familiar with the process of developing proposals that utilize onboard equipment. To understand the role of Chief Scientist in the execution of a successful cruise.
19. Become familiar with new equipment and techniques. Develop connections for future collaborations.
20. Broadening my knowledge of the ship capabilities and research interests of geophysics.

11. What were your anticipated outcomes by participating in the Chief Scientist training cruise? (Post-cruise with *self-described outcomes*)

Response Summary
  Positive => 18
  Mostly Positive => 2

1. Get first hand experience with mapping equipment.
   Yea
2. To gain experience at sea and come away with increased knowledge of the scientific possibilities offered by modern research vessels.
   Yes, and much more
3. Get to know more about proposal writing, ship time request and onboard equipment, geological and geophysical data acquisition systems,
   almost...
4. I came mainly interested in developing leadership and soft-skills required for organizing, funding and executing as chief of complex ocean-going teams. On a second level of priority, I wanted to learn about ship technologies, how to use them, how to collect and access their data and how to know the right technology to apply for different purposes, in different environments or with different limiting circumstances. The specific science objectives of the cruise were at the bottom of my expected outcomes, since I didn't know/understand the science in depth - but now I do!
   Yes, plus many outcomes I did not anticipate. I learned about topics of marine science that I am not an expert on and recognized the transferability of multidisciplinary skills, technologies and theory between our fields.
5. I was hoping to better understand how to access UNOLS ships for research and how ship time folds into the greater proposal process.
   Yes
6. Gain at sea experience and become more familiar with NSF proposal components and outcomes.
   Yes
7. Get to know different kinds of equipment that can be used on a research cruise. Learn more about the funding process as well as the process that researchers go through to plan and execute a cruise.
   Yes, I think broadly we learned about how to come up with a plan, and the role of remaining flexible but having a detailed and meaningful research plan. I do feel like all of the group projects stemmed from where we were sitting in the classroom. It was hard to get involved in a project after the fact, even though many of the groups were open to new additions. I know this is partially due to the time we had to plan, but I feel I missed out on some of the planning components because of this.
8. My anticipated outcomes were to gain experience at sea and to fully understand the process of proposal writing in which the primary aim is to conduct research at sea.
   Yes
9. Demystifying the NSF proposal process, particularly with regard to sea going science
   Yes
10. Learn the responsibilities and necessities of coordinating a larger scale science project. I hoped to learn the pathway to bringing interdisciplinary research together, and the difficulties and solutions to make it work.
    Very much so. Getting an idea of the scope of Chief Scientist and having a chance to practice gives me the experience I need to host a cruise.

11. Learn more about the components needed for nsf proposals. Learn how to better communicate with the ship's crew.
    Yes. Definitely more comfortable interacting with the crew. Understand more about nsf proposals but I think would take writing one to really understand all parts.

12. To gain a better understanding of the NSF proposal process and to gain more experience in other shipboard instrumentation besides multibeam.
    Yes

13. My anticipated outcomes were to observe and participate in a scientific cruise, learn the process to obtain ship time, and gain valuable experience.
    Yes, the cruise gave me a good understanding of how to complete a science survey, obtain funding for ship time through proposal writing, and shed light upon the possible hardships faced while at sea.

14. My main objective was to learn how to design, organize, and successfully carry out a ship-based field campaign.
    Yes. The hands on approach to the design, implementation, and carrying out of a research project while on shore and aboard the ship was successful. In addition, the design of the training program also afforded the opportunity to learn how to manage fellow scientists in order to make sure that the objectives of the project were paramount in the ship-based effort.

15. Learn how to use new equipment and their applications, gain knowledge on writing proposals and how research vessels operate.
    Yes.

16. Learn how to write a proposal
    Pretty well

17. Anticipated outcomes of participating in the Chief Scientist training cruise were to better understand proposal writing and applying for NSF funding, particularly in regards to sea-going research, as well as gaining experience on a large research vessel so that I might get a feel for research at sea and the ship's capabilities while at sea.
    Yes! I learned a lot, both in regards to the ship and it's capabilities, and equally about applying for NSF funding/proposal writing/requesting ship time, etc.

18. Better understanding of the proposal process and the steps involved.
    Very much so. From this program I feel much more comfortable in submitting a proposal and in reviewing a proposal.

19. Learn about proposal process. Learn about requesting ship time. Network.
    Most definitely yes.

20. To get training on how to write successful scientific proposals to get funding. To get training on being chief scientist on board ship and communication with ship crew.
    Yes, although I think it would have been nice to get more pre cruise planning to get ideas together a bit before getting to Hawaii and on board ship. Having said that, it was really nice to also make the best use of the tools on board ship to get done what was necessary (such as no geomapp app or limited internet) as likely as a scientist on board ship or in the field, one will have access to limited resources but still have to do science to make the best use of time, money, available equipment and circumstances.

12. Did you feel the lectures/activities prior to the cruise were useful/helpful to prepare you for the cruise? Please comment on what you liked and what you thought could be better.

Response Summary
- Positive => 7
- Mostly Positive => 9
- Mixed => 2

1. Yes good background provided
2. They were all very helpful. I enjoyed the opportunity to take part in planning stops along the cruise path, although a few days to research sites beforehand would have benefited.
3. They were useful, but i wish we had a prior schedule. We do not really know what was coming up.
4. I missed the first day of lectures so I can only comment on 50% of the pre-cruise activities. On the 2nd day (Wed), I felt some disorganization or excess time that instructors at times didn't seem to know how to fill. In my opinion, we spent too long reviewing each of the ship's website pages, which some of us had already done at home - and should be mandated homework before arriving. The time dedicated to working in groups calculating transit duration/distances + establishing objectives was well used and kickstarted the dynamic hands-on experience that became the rest of the cruise. All in all, I would suggest organizing a schedule/syllabus (maybe I wasn't there on Day 1 if one was discussed) to make sure the time in classroom on land is used more productively. For example, I would suggest a tour of labs/facilities/guest lectures with host university. Surely researchers at UofH have performed similar cruises and used geophysical/geological data of HNL-SAN transits before, so they could prepare us well on what has already been done in the local area and what results/outcomes have been discovered + what questions remain for us to tackle. Another idea would be to have each of the participants (us) present a 4min talk on our research, as a ways to meet each other and bring forth our interests.
5. Yes, although I think there should have been more done prior to arrival in Hawaii. I think a better approach would of been to have everyone arrive with a complete proposal and then worked on improvement and planning in Hawaii. But I enjoyed the mock panel format.
6. The overview of geomap app was good. I really enjoyed mapping out the transits and possible project locations. That was interesting and useful. didn't really get the value of going page by page through the Sikuliaq website, when we got that information again onboard. I think more project planning would have been better.
7. Yes, the lectures were helpful but would have been better if there were a more rigid structure pertaining to the development of a research plan for the cruise.
8. Yes
9. 16 hours seemed a bit much for what we were covering. I'm not sure what else to fill the time with, because we got to generate science projects.
10. Overall I think it was good to have the days before the cruise. I think we could have had less about the boat (since we get that on the boat and easier when actually seeing it) and more planning of projects while internet was more available. I thought it worked out well to have the different groups plan sections but maybe would have been better if people could choose which group instead of assigned randomly.
11. I thought the pre-cruise lectures were mostly great. Looking back, I think more emphasis could have been put on what watchstanding means and the responsibilities of watchstanders, because it seems some people did not take it seriously.
12. Yes. It would have been helpful to have some materials to read and prepare for prior to arrival in Honolulu that would have helped those with less ship time experience prepare for the first day.
13. They were helpful. a basic overview and explanation of the equipment and applications right off the bat would have been helpful (instead of using acronyms "CTD, XBT, etc. on the first day and not

spelling it out for those who have never been on a ship). I felt lost not knowing much about anything, but I later found out, so did many others.

14. Yes, especially not being familiar with the area we were going. Having time to become acquainted with the area and some of the literature was very helpful.
15. I did find the pre-cruise lectures and activities to be helpful in preparing. I liked having a classroom setting to go through expectations while on the ship and the ship's science capabilities. I greatly enjoyed our time at the Hawaii Institute of Geophysics and think it was really important for the group to get to know each other and discuss the upcoming research prior to departing. I would have felt a lot more prepared if we had been provided a list of suggested items to bring, a brief rundown of what a "day in the life on the ship" might look like, and an itinerary for the pre-cruise lecture days before leaving my hometown. For example, having never been exposed to this type of research before, and having never lived on a large research vessel before, I brought my full rubber rain gear and boots thinking that we would spend a lot of time out on deck; however, in reality we spent most of our time in the indoor, on-board laboratory. I have no complaints about this arrangement! I just wish I'd known ahead of time so that I would have packed more accordingly.
16. Yes, but the addition of additional paper resources would be helpful. Even print offs from the NSF site might be helpful.
17. Yes, useful. I liked the anecdotes.
18. Yes! Definitely but would have been nice to know that we couldn't use tools such as geomapp app on the cruise. Also, not sure why we were acquainted with it before cruise as we wouldn't have used it. Perhaps it would have been to everyone's benefit to get acquainted with GMT instead.

13. Did you feel the presentations after lunch during the cruise were useful/helpful for understanding shipboard operations and requirements for successful ocean-going proposals/projects? Please comment on what you liked and what you thought could be better.

Response Summary
Positive => 9
Mostly Positive => 9

1. Yes I liked learning the structures and dynamics of NSF proposals.
2. Yes, they were helpful. The presentations were all very focused and the topics were diverse. I enjoyed that the presentations invited insightful discussion among all participants.
3. They were certainly useful.
4. Yes, these presentations were a highlight of the cruise, especially in my case not having a background in many of the techniques we were applying (gravity anomaly data, coring, etc). The talks on NSF grant writing/applying and accessing ship time from UNOLS were clear and thorough, covering all the important aspects. Plus plenty of time for questions, of which I had a lot. :)
5. Yes, these were critical part of the trip. The only thing that might have been interesting was to require each student to do a 10-minute presentation on their own research during this time period.
6. Yes, school was great. I enjoyed the diversity of NSF-related presentations and science-related presentations. It was also great to hear from experts in our group. I can't think of anything in particular I would have changed about those talks.
7. Yes, those were spot on.
8. Yes
9. The lectures were good. Some of the mechanics of proposal writing are a bit dull, but there's no way around covering the expense report. The most valuable bits were stories and examples of, say, past cruise reports or applications. Pitfalls are always good to know.
10. Overall I thought they were helpful. If at all possible would have been nice less lecture-based and more activity would have been great. If could somehow pretend to fill out a budget for example. But I understand that is difficult.
11. I thought the lectures during the cruise were great.
12. Yes. I think that an emphasis on the instrumentation and data collection earlier in the cruise would have been helpful to project design.
13. They were helpful, however, the assignments (proposal, cruise report, etc.) could have been given more directly to the whole class with requirements and deadline, rather than hearing it from a group memeber that we have a report due, but not sure when or exactly what needs to be in it, etc.
14. Yes, it would have been nice to hear from more of the students about what they specialize and how it could be utilized on the ship.
15. I really enjoyed the lunch-time presentations. Particularly the ones regarding NSF proposal writing and applying for NSF funding. As this was not my direct field of study, I did not always fully comprehend the lectures on the science equipment, but I was glad to have them presented so that I could get a better sense of the science we were doing on board. In some ways, I wish the science equipment lectures had been given prior to the start of the cruise, but in other ways it makes sense that it came later on when we were a little more oriented to the day-to-day activities of data collection.
16. Yes, same as above. It would also be nice to have a written schedule for what material will be covered and when.
17. Yes, useful, again with personal experience Rob and Bernie provided. However, I would only have 3-4 per week
18. Definitely yes. I think for future cruises it should also be encouraged that the groups undergoing operations should update everyone in the room where they are with their survey area as well.

14. Did you feel the watchstanding activities were useful/helpful for understanding shipboard operations and requirements for successful ocean-going proposals/projects? Please comment on what you liked and what you thought could be better.

Response Summary
- Positive => 5
- Mostly Positive => 9
- Mixed => 5

1. Yes, though while in transit watch was a bit slow.
2. Yes, the watchstanding activities were well explained by the primary instructors and the ship's marine technicians. The watch teams were a good size and the 4-on-8-off shift rotation worked out well.
3. Some of them were useful. Some could have been better. For example, we learned very little about multibeam processing by editing the bad pics. Instead if we had gone through the whole processing steps, that could have been better. Similarly, for gravity data we were never shown how to do the gravity processing except for one hi-fi lecture we blew off most of our heads. The shifts were a bit over crowded with some of them doesn't even know what they were doing.
4. The 4on/8off schedule was hard to get used to, but understandable that made the most/fair sense. 7 people per shift was more than enough for watching the sensors (especially before actual surveying), but it was very positive to have a mix of more experienced vs. more junior peers in each group. We were lucky to have a long transit at the beginning, to give time for groups to find their own organizational rhythm and practice roles before arriving to the most intense science locations. In general, watchstanding was valuable time to learn about the operations. I wish deck work had been more equally distributed too, to give everyone access to doing the hands-on stuff, but understandably that is harder to synchronize and may require more specific skills that only certain people have.
5. The watch standing was helpful. Although it would of been improved if the beginning of the trip had more watch standing duties, but of course Hawaii did not allow for this.
6. Yes, it was nice to get to know each of the different instruments onboard. Some shifts were slower than others, but I don't know of a better way that they could have been split, given the first half of our cruise was mostly transit. I think the 4 on, 8 off watches ended up working out very well for these purposes.
7. I gain knowledge better by doing rather than listening so the watch-standing activities were key for my learning.
8. Yes,
9. It would have been helpful to have more structured briefings by the marine-tech on watch stander duties, particularly how to run the instruments. Leaving this to the science party was akin to a game of telephone.
10. Watchstanding is necessary, but not terribly exciting to me. Although I hate to say it, leaving the groups to organize themselves on watch led to a lot of confusion and dropping the ball in some cases. I feel if we had properly anointed the "Chief Scientist of the Day", that wouldn't be such a problem.
11. Yes. We had more people than necessary which sometimes was a little frustrating but that couldn't be helped.
12. Yes. However not everyone pulled their weight. When some folks were asked to take a turn processing data, they simply said no.
13. When some people were asked to take a turn watching the multibeam they said "why? I don't care about seafloor data. It's just colors on a screen."
14. Mostly. The amount of time during transit made for good opportunity team building, but a lot of down time.

15. They were helpful, I did learn a lot, however more guidance and interaction would have helped. Or if we were given small assignments during the watch for the instrument we were working on to help us better interpret the data on the screen. More hands-on operations would be great.
16. Yes but there needed to be less people on each shift. The first couple days were a bit hectic and it took over a week to become acquainted with the software and tools.
17. Yes. If it weren't for the watchstanding activities, I would not have understood a lot of what was happening. Particularly in the beginning of the cruise when we were just transiting, I really did not understand what was going on, what the purpose of the instruments were, or what information those instruments were relaying. Although I think it was extremely beneficial for us to have that initial transit only time in order to orient ourselves to what we were seeing so that once it came to survey time, we had a better grasp of how to handle things as they came up or changed. Now that we are finishing up the cruise, I feel I've come away with a much greater understanding of what we did and why, what the instruments do and show, what the ship's capabilities are or can be if we were to bring additional equipment, and I was really able to recognize what was going on in the lab and more importantly, what needed to be done at various times throughout our research.
18. Yes, it worked out quite well, especially for the A Team. Having mock situations might have been good to help add some complexity to the shifts (and an opportunity to learn new things). For example, working with marine techs to service/inspect equipment. Developing plans and logistics.
19. Yes, however there were not enough jobs for the number of folks present. Divvying it up further, within groups, so that seven people could negotiate and decide how many were on their watch at any one time, could have proved helpful to work on task delegation and negotiation within the scientific party, a good skill to have on cruises.

15. On a professional level, what are 2 things that you think will be the most important result of your participation in this cruise 5 years from now.

1. Good base of knowledge of developing ideas as a chief researcher in seasoning since and the ability to produce NSF proposals.
2. Knowledge of the ship's capabilities and operations, and experience using the onboard equipment.
3. Sea going experience and proposal writing.
4. Network of peers that may lead to future collaborations. Better understanding of marine geophysics/geology and how it connects in the field to oceanography.
5. The two most important things are connections with fellow students and the faculty leading the trip, and the recognition of how marine geophysics can be used to understand the problems I currently research.
6. A better understanding of the funding process, and some strategies that may help me make my project more competitive. Experience critiquing research plans, and figuring out what makes a strong hypothesis.
7. I believe a better understanding of how oceanographic research is done and executed. Hopefully that will turn into a proposal being funded to go back!
8. More likely to write a grant for sea going science. More likely to use existing R2R data to solve a scientific problem. Gained experience with multibeam processing
9. Mechanics of the cruise report. Examples of good and bad writing.
10. More comfortable interacting with the ships crew and how to work with them to accomplish the science. I think this will make taking on the role of chief scientist less daunting. Learning more about budgets for proposals and booking ship time. Didn't know much about it before.
11. I feel more confident about the NSF proposal writing process. I learned that you cannot over emphasize the importance of data. You may think you've made it clear, but some people still won't understand why they should care.
12. I feel that I have made good professional connections that could lead to interesting collaborations in the future. Also, I feel that I have gained new experience in working with other scientists whose goals/ambitions may lie outside those agreed upon during research planning.
13. Ability to successfully execute and work on a research vessel for an extended amount of time (with a large group working together), Broadened my skillset to include not only geological mapping on land, but also using new advanced equipment to survey, map and correlate geologic deformation history and new features offshore
14. The writing experience and working with others.
15. First and foremost, I think the most important result of my participation in this cruise is my desire to participate in more cruises in the future. In turn, this will likely lead to an NSF application for ship time if and when my research falls in that place. Secondly, I think the knowledge learned about applying to NSF funding is applicable to several (if not all) funding agency applications; proposal writing and submission for funding is an important and learned skill, and the things I learned on this cruise will be things I can apply throughout the rest of my career.
16. Development of a broad and varied network of fellow scientists and professionals in interests outside my own research field. Starting off my professional career with an improved sense of how and why the NSF/UNOLS system works.
17. Better understanding of cruise submittal process. This experience made the task far less daunting. The network I've made, and friendships, within the scientific university across broad fields and institutions.
18. For me to co-submit a research proposal to do a drilling operation for my research and encouragement as a postdoc in proposal writing.

16. On a personal level, what are 2 things that you think will be the most important result of your participation in this cruise 5 years from now.

1. Learning the demands of going on a research vessel and how to efficiently work with others as equals.
2. Experience at sea aboard a research vessel and interacting with a team of diverse scientists and the ship's crew.
3. Appreciation for good ship crews who make all the complex hidden bolts turns, while we just focus on the science. Hands-on experience at sea playing with new hardware is something I can never get tired of!
4. It is cool to just be able to say I crossed half the pacific, definitely a unique experience.
5. The connections I have made with other early career researchers who have similar interests and are in the same field. More experience dealing with social dynamics when limited people are trapped in a small space. It was great working with a positive group of people who were accommodating and eager to work together and help each other.
6. The connections made with other people and the experience as a whole has changed my perspective on many topics.
7. Unsure, but if I'm not having fun I'm not doing it right!
8. Group dynamics blew my mind. I figured with a lot of professional scientists in the room we would easily organize and successfully present and discuss ideas. However, instead we see what happens whenever any group of humans gets together. The strongest personality dominates, sometimes to the detriment of the project. Weaker personalities with useful insight or corrections on facts were often ignored or "shouted down".
9. Networking with other early career scientist and learning how to make science decisions a little on the fly.
10. More comfortable interacting with the ships crew and how to work with them to accomplish the science. I think this will make taking on the role of chief scientist less daunting. Learning more about budgets for proposals and booking ship time. Didn't know much about it before.
11. One thing is that I made a new group of pals. My fellow watchstanders were great. I also enjoyed the opportunity to interact with the crew.
12. Own it! Not being intimidated to write a proposal or apply for advanced programs/jobs, knowledge of new equipment/applications and getting through the cruise successfully and happily!
13. The writing experience and working with others.
14. The confidence to request ship time for my own research and the ability to work directly with ships crew to plan and execute science at sea.
15. Communication with the ship crew and the necessity to make clear decisions, communicate well, and know what exactly you need to do during the cruise.

17. Please provide any further comments on what you liked, disliked, or thought could be done better to make this training cruise a success.

1. Rob and Bernie did a great job.
2. Don't really have any complaints, other than maybe a bigger gravity core (and maybe Jason, haha).
3. The cruise experience is certainly useful for future proposals. I wish NSF encourages more such cruises in the coming days to help young scientists. Got acquainted with the shipboard operations. Marine tech, Bern Mckiernan was great and was always willing to help us with a smile. The captain and crew were very supportive. Excellent chefs and Annie who took care of us so well.
4. Couldn't have asked any better ship facilities, instrumentation, food. All top notch! The ship crew was not only knowledgeable but so nice and approachable, that makes interactions that could potentially be tricky, smooth and productive. Instructors kept the environment professional but informal. The why and what we were there to do were always clear, but it didn't mean we couldn't have fun in the process. I would widen the scope of the Chief Scientist cruises, to not be focused on just one/two fields (geology/geophysics), but allow for more multidisciplinary science to be done in parallel. That way everyone could learn about a scientific field they didn't know much about and together connect the dots to the bigger picture. I wish I had done this earlier in my career!
5. It was great working with a responsive crew. They were all very helpful, and just great people to get to know. Way to go, Sikuliaq!
6. This was an amazing opportunity that I will never forget. I thank you guys so much! I firmly believe that this has made me grow professionally and personally. It has given me the itch to go back to sea to conduct my own research.
7. Gentlemen, Overall this experience was thoroughly enjoyable and educational. Thank you for organizing it. The lectures struck a good balance of theory and practice and were highly informative and entertaining.
8. The crew and marine techs were fantastic. Overall the objectives of training for chief sci position were successful.
9. Would be really great to get an AGU session incorporating chief scientist cruises!
10. I enjoyed the cruise and learned a lot, but was frustrated with the attitudes of some of the participants. An entire shift not noticing bad multibeam data for over an hour during an active survey because they were all playing cards and no one was even facing the screens. People saying they don't want to do sub-bottom or multibeam sonar watching because it doesn't matter to them. These guys need to learn that as Chief Scientist they will HAVE to care about all the data. Furthermore, their attitudes seemed inconsiderate to everyone else working hard to process data and watch all the equipment to make sure we did have high quality data.
11. At this point, I can't really think of anything. Thank you Bernie and Rob for making this opportunity possible.
12. more communication about plans (or change of), assignments, etc., More hands-on operations, more interpretation of data and data processing.. what will we do with the data now? or how do we process and get it on a map? or into a global database like geomap app or arcgis?
13. Although, I enjoyed everyone's company I feel like it would be more beneficial to have less people. Requiring pre-preparing for the cruise would also be beneficial. As in you are required to justify a "proposal" or idea when you arrive.
14. I really loved the group of people. Not every person was a geologist and I think that made for a really interesting group and cruise. It's important to get out of your little bubble of research and see what other people are doing, to brainstorm with others, and to network as well. I'm very grateful for the opportunity to meet all these wonderful people and share our knowledge with each other. The crew on Sikuliaq was really awesome as well. I've pretty much already mentioned my likes and dislikes in previous responses on this survey, but overall I think the cruise was a great success. I certainly accomplished my goals for participating. I thought the pre-cruise organization could have been better - particularly before arriving in Honolulu. I had no idea what to expect from the cruise,

the ship, the experience, or anything. I would have liked feeling more prepared before arriving on site.

15. Take advantage of our individual skills while at sea. Request more science equipment/fund shipment of samples/box of instruments to and from the cruise.

I think made all the comments necessary, generally everything was absolutely great and couldn't have asked for a better training experience and better use of time!