Comparison Of Glacial Geomorphic Features In Antarctic Peninsula Fjords Based On Multibeam Swath Bathymetry Data

Y. Muñoz, J.S. Wellner, K.A. Mead, and L.A. Hardin

A distinctive suite of subglacial geomorphic features, representing the grounding of an ice sheet and its subsequent retreat, has been well-documented as occurring on many parts of the Antarctic continental shelf. Elements that characterize this suite include meltwater channels, drumlins, mega-scale glacial lineations, and gullies. Many of these same elements occur in more recently deglaciated fjords, but at different scales and in different combinations. Bathymetric soundings have been collected during transit onboard the RV/IB Nathaniel B. Palmer in various expeditions to the Antarctic Peninsula. Multibeam swath bathymetry data were acquired using a Simrad EM120 hull-mounted swath profiler consisting of 120 beams of 12 kHz data. The data were edited for anomalous readings by the scientific party of each cruise while onboard; later the data were gridded and processed to create relief maps. The vertical and horizontal resolution of the data is 10 meters. The study includes ten fjords on the north and west side of the Antarctic Peninsula, from the Graham Land Coast around to Hope Bay as well as on Anvers Island. The multibeam data has been reprocessed using different software packages including MB Systems, ArcGIS, Fledermaus, and CARIS resulting in high-resolution images. The different methods used to plot the bathymetric data complement each other as the capabilities of each method vary. Diverse measurements, including dimensions of the different morphological features, and calculations like slope, ice drainage area, and sediment volumes were made using these acoustic techniques. Comparison of the geomorphic features from the ten fjords show certain trends. Meltwater channels are much more prevalent within the fjords than on the open shelf. Mega-scale glacial lineations within the fjords have much shorter average lengths than those on the open shelf; this is attributed to the irregular seafloor topography that characterizes the fjord floor. Finally, some fjords are characterized by a series of back-stepping grounding zone wedges, which mark times during which ice was stabilized during retreat. The locations of these pauses in retreat correlate to narrow and/or shallow parts of the fjord and demonstrate the control of pre-existing bathymetry on ice retreat. The multibeam data provide a better understanding of the geomorphic features in each fjord and thus a clearer interpretation of the retreat history in each of them. ■

Subsurface Imaging with VSP and Ocean Bottom Seismometers (OBS): Novel Acquisition Designs

Emin E. Pacal and Robert R. Stewart

Recording of ocean-bottom seismometer (OBS) data has several advantages over conventional near-surface recording. Because of their deployment on the sea floor, OBS are less vulnerable to noise and disturbances in the water column and thus have a relatively higher signal-to-noise ratio. OBS also offers wide-azimuth (WAZ) and full-azimuth (FAZ) geometries, which are important for imaging the complex structures such as salt domes. Vertical seismic profile (VSP) reflection surveys help to define a salt-sediment interface near a wellbore by using offset sources. VSP with circular shooting has been using for 3D imaging near the borehole. VSP itself, however, still has some limitations such as poor offset and angular coverage per bin and limited total bin fold. This imaging limitation in the VSP can be lessened by combining ocean-bottom seismometers on the sea floor with the VSP borehole survey. We show a number of model examples using combined borehole and ocean-bottom recordings to improve azimuth, offset and fold distribution. Survey designs were created in OMNI 3D to compare and examine.

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We use 10 concentric circles separated by 200m and 50m shot interval to create circular shooting geometry. Same shooting geometry was used to create joint VSP and OBS survey. The results show that the joint VSP and OBS survey has better fold, offset and azimuth distribution than VSP itself. ■

Practical Applications of the Ground-roll Inversion

Soumya Roy

Estimation of the near-surface shear-wave velocity structures is very important for different petroleum as well as non-petroleum purposes. Shear-wave velocities can be derived using the ground-roll inversion method. We have used the Multichannel Analysis of Surface Waves (MASW) method to estimate those velocities. This method is based on the frequency-dependent properties of the ground-roll. Once the high-resolution shear-wave velocity structure is estimated then it can be applied for various practical purposes. In this paper, some of those applications (density prediction; and statics estimation) have been presented. A proper knowledge of two important rock properties - seismic velocity and bulk density can be very helpful in estimating the reflection coefficients and hence generating synthetic seismograms. If density information is unavailable then it can be predicted by using Gardner's relation. We used a modified Gardner's relation to predict bulk densities from shear-wave velocities estimated from noninvasive ground-roll inversion method. Different types of seismic data sets have been used- i) Modeling data (numerical and physical modeling);and ii) Field data: Red Lodge, Montana, and the Meteor Crater, Arizona. Predicted densities are consistent with known values with maximum error of 0.5 gm/cc. We find exponential values for the modified Gardner's relation formula varying from 0.21 to 0.234 while the suggested value is 0.22. The prediction of bulk densities for varied materials maintains a confidence level of above 90 %. Another important application of the ground-roll inversion is the calculation of the simple shear-wave statics which can be used during the multicomponent seismic analysis. For highly complex, unconsolidated, low-velocity near-surface of the Meteor Crater site, the simple shear-wave statics are calculated which vary between 40 to 70 ms for a 45 m deep model. ■

Oligocene Shortening in the Little Burro Mountains of SW New Mexico and its Tectonic Implications

Donald W. Tomlinson, Peter Copeland, Thomas J. Lapen and Michael A. Murphy

There are numerous well documented examples of Laramide-style shortening in SW New Mexico. Ranges such as the Big Hatchets and the Florida Mountains exhibit classic examples of Laramide thrust faulting. Unfortunately the youngest part of the stratigraphy for this region is Cretaceous, rendering it difficult to bracket the age of Laramide termination. From sparsely known Laramide ages in the region, it is suffice to note that Laramide shortening in SW New Mexico has proven to be more complex than most modeled interpretations are capable of deducing. Recent observations by Copeland et al. (2011) show that shortening is younger than 34.6 Ma in the Silver City Range of southwest New Mexico. This has important implications for the timing and nature of the switch from regional shortening to regional extension.

The Little Burro Mountains were targeted for further studies due to structural similarities with the Silver City Range (Paige, 1916). The stratigraphy of the Little Burros consists of a Prtoterozoic granite basement unconformably below Cretaceous Beartooth quartzite and Colorado shale. Unconformably above the Cretaceous units are a series of Tertiary volcanic rocks. They consist of andesite lavas and breccias succeeded by the tuff of Indian Peak and the tuff of Wind Mountain. A Tertiary basaltic andesite and fan deposits unconformably cap the tuff of Wind Mountain.

Field mapping focused on the Tertiary volcanic rocks and how they relate to the Laramide deformed Cretaceous beds. The results clearly show a monoclinal fold with an axial trace trending NW-SE. This corresponds with the structural style of Laramide for the rest of the region, which is generally agreed to be caused by a NE propagation of shortening (Bird, 1988; Seager, 2004). The Little Burro monocline displays modestly dipping beds of ~12° in the backlimb, which steepen to ~30° in the forelimb. Field evidence and trishear fault-propagation-fold modeling supports the idea that the broad interlimb angle of the Little Burro monocline is derived from a deeply rooted blind thrust fault. Normal faults run orthogonal to the axial trace of the fold with low displacement (10s of meters). They are interpreted to have formed from variations of shortening along strike of the thrust Sheriff Lecture Poster Competition Abstracts continued on page 25