Marine geology and geophysics

Glacial-interglacial depositional model in Bransfield Basin, Antarctica

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Based on approximately 2,600 kilometers (km) of high- and intermediate-resolution seismic data and 100 sediment cores, a detailed seismic facies analysis was conducted in Bransfield Basin (figure 1). Results of the study include the following:

- the distribution of the lithologies present in Bransfield Basin seismic facies;
- a depositional model for Bransfield Basin through past glacial and interglacial periods; and
- a reconstruction of the extent and thickness of grounded ice during the last significant grounding event in the basin.

Seismic facies analysis led to the differentiation of distinct glacial subenvironments: distal glacial marine, proximal glacial marine, grounding zone, subglacial, and acoustic basement (figure 2). The identification of seismic facies was based on intensity of acoustic contrasts, morphology of bounding surfaces, and geometry, intensity, and frequency of internal reflections. The procedure is derived from the work of Vail et al. (1977) but is adapted for smaller scale, higher resolution features (Belknap and Shipp 1991). Lack of core control necessitated the use of other seismic facies investigations to infer lithologies for the seismic facies examined in Bransfield Basin. Once the seismic facies were identified, they were compared to glacial marine seismic facies of the Northern Hemisphere (King and Fader 1986; Vorren, Hald, and Lebesbye 1988; Mosher et al. 1989; Vorren et al. 1989; Stewart and Stoker 1990; Stoker 1990; Vorren, Lebesbye, and Larsen 1990; Anderson and Bartek 1992; Belknap and Shipp 1991; King et al. 1991; Stoker et al. 1992; King 1993). Facies that resembled each other were inferred to consist of similar sediments and to have had comparable depositional histories.

Division of sediment cores into six general lithologic types, based on detailed core descriptions of textural and compositional character, led to an understanding of the modern interglacial setting. Because the sediment cores are less than 10 meters (m) in length, it is not possible to link them directly to the seismic records although, based on similar facies distribution patterns, the interglacial and glacial settings seem to be closely connected. Examining the lateral extent of the seismic facies led to the interpretation of the glacial setting and, in conjuction with an understanding of the modern interglacial setting, the development of a depositional model for Bransfield Basin through the past three glacial-interglacial periods.

A glacial reconstruction with more than 700 m of ice grounded in approximately 600 m of water is developed by examining the modern water depth at the maximum extent of

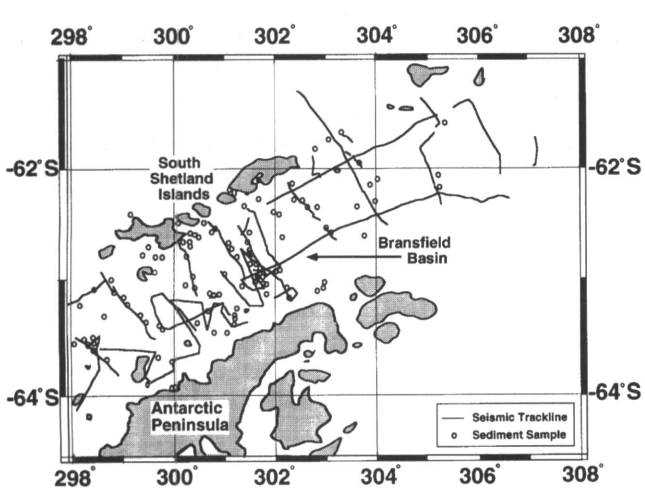

Figure 1. Map showing the location of seismic tracklines and sediment samples in Bransfield Basin.

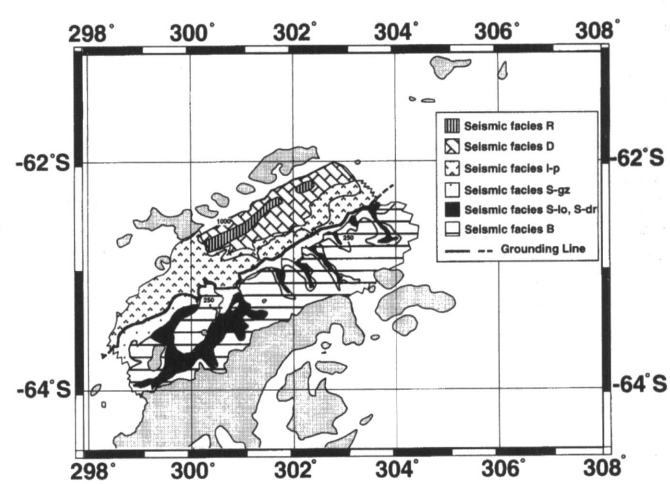

Figure 2. Map showing the distribution of seismic facies in Bransfield Basin and the grounding line of the last significant glacial episode. Seismic facies B is interpreted as acoustic basement, S-lo and S-dr as subglacial deposits, S-gz as grounding zone deposits, I-p as ice-proximal deposits, D as ice-distal deposits, and R as a volcanic ridge. The 250- and 1,000-meter isobaths are marked on the map.

glaciation, subtracting the eustatic sea level drop due to glaciation, and then performing a density calculation. Recent glacial reconstructions in Ross Sea predict greater grounded ice thicknesses than would be determined with density calculations (Denton, Prentice, and Burckle 1991). Thus, the ice thickness in Bransfield Basin could have been much greater than the calculated 700 m.

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A geochemical sedimentological analysis of glacial marine sediments from the Palmer Deep Basin, Bellingshausen Sea, Antarctica

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The sediments off the Antarctic Peninsula contain a history of the advance and retreat of glaciers and paleoclimate change. The Palmer Deep Basin is located on the Bellingshausen Sea Continental Shelf, 5 kilometers south of Anvers Island (figure 1). Piston core *PD*92-30 was collected from the basin during the R/V *Polar Duke* 92-2 research cruise. This study focuses on the geochemical, magnetic susceptibility (MS), and total organic carbon (TOC) variations in the core.

In the Antarctic Peninsula, MS has proved to be a useful paleoclimatic indicator due to distinct sediment source changes that accompany changes in climate (Domack and Ishman 1992). A low MS value corresponds to a high biogenic content and low terrigenous material (Domack and Ishman 1992). High MS values are not found where ice-rafted debris is within the core; therefore, high MS values for core *PD*92-30 are a product of the fine-grain hemipelagic component of deposition (Kirby 1993).

The depth vs. MS graph (figure 2) for core *PD*92-30 shows wide variations in MS for the upper 580 centimeters. From 580 centimeters down, a trend of low MS values with small fluctuations is apparent. The MS variations are related to variations in biogenic material in the core (Domack and Ishman 1992). To gain a better understanding of the relation between MS and biogenic material, a geochemical analysis of the core was performed at various depths. Nine samples from alternating low and high MS were analyzed by x-ray fluorescence for the major and trace earth elements (table). The plots of strontium/MS (Sr/MS), aluminum oxide/MS (Al_2O_3/MS), calcium oxide/MS (CaO/MS), potassium oxide/MS (K_2O/MS), magnesium oxide/MS (MgO/MS), and titanium oxide/MS (TiO_2/MS) have a direct, positive sloped, linear relationship to MS. The graph of silica/MS (SiO_2/MS) has a direct, negative sloped, linear relationship to MS (figure 3).

The observed TOC of core sediments is controlled by the