Uncovering the Footprint of Former Ice Streams off Antarctica

Antarctic ice sheets and ice caps have been expanding and contracting following global climatic cycles. The last time the Antarctic ice cover peaked, at least in Western Antarctica, was ca. 21 by supposing the Last Glacial Maximum (LGM). During that period, sea level was approximately 120 meters lower. However, sea level and climate change at a global scale.

Ice streams are a key element to solve the puzzle linking ice sheet stability, sea level change, and climate change at a global scale. The stability of ice sheets is largely dependent on ice discharge, which mostly occurs via ice streams flowing along glacial troughs. Ice streams are thus a key element to solve the puzzle linking ice sheet stability, sea level change, and climate change at a global scale.

Recent advances in marine geophysical and glaciological studies, such as ice sheet modeling, allow us to better understand the relationship between ice streams and the Antarctic ice sheet. In the near future, understanding the Antarctic ice sheet will help us better understand the climate system and its response to past and future changes.

How does the Mesozoic Dipole Low Really Exist?

Documenting variations in the virtual dipole moment (VDM) of the geomagnetic field through geologic time has recently been the subject of considerable interest. The VDM is a measure of the strength of the Earth's magnetic field and is thought to be related to changes in the Earth's interior. The VDM is defined as the virtual dipole moment (VDM) of the Earth's magnetic field, which is a measure of the strength and orientation of the Earth's magnetic field at a given location.

The VDM is calculated by integrating the magnetic field over the Earth's surface. The VDM is a useful tool for understanding the Earth's magnetic field and its variations over time. The VDM is also useful for understanding the Earth's interior and its evolution.

The Mesozoic Dipole Low (MDL) is a period during the Mesozoic era when the Earth's magnetic field was weaker than today. The MDL is thought to be related to changes in the Earth's interior, such as the movement of tectonic plates and the formation of the supercontinents.

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topography and roughness, and the production of dust that could be incorporated into
basal till. Basal ice-flow conditions change
substantially if ice is grounded on bedrock or
on sediment. The slope angle both of the ice
base and the ice surface determines the grav-
itational effect on flow speed and the genera-
tion of frictional heat. The climatic setting influence on both production of the ice
boundaries and inside the ice masses. It also
determines precipitation rates, thus governing
loading and gains of the ice mass. In the long-
term, climate determines the stability of glacial
systems. Marine terminus ice-stream and
glaciers are particularly sensitive to sea level
fluctuations causing them grounding and
degrounding on the sea floor.

The Long-term Record

The extension and transport efficiency of sub-glacial depositional systems must be
directly related to the wearing and winning of grounded ice sheets in parallel, masscale
streamlining must have occurred repeatedly since the onset of glaciation in Western Antarctics,
sometime between 24 and 28 million years ago.

To elucidate the long-term history of glacia-
 tion is necessary to investigate the sedimentary
sequences that build the record of ice volume
fluctuations. Differently, perspective, multi-
channel seismic reflection profiles have shown
large erosive surfaces on the continental shelf as
depths far below the range of eustatic sea
level fluctuations.

The association of an oversteepened, land-
ward-facing, continental shelf with an over-
steepened continental slope was considered
universally in indications of sedimentation
under the influence of an ice shelf grounded
on the continental shelf edge. However, identi-
fication of those morphostratigraphic characters in
the deep-sea record becomes more difficult.

Earlier interpretations of deep penetration
seismic reflection profiles were questioned by
Weaver et al. (1990). In contrast, high-resolution
profiles parallel to the margin. These revealed a prevail-
ably unknown depositional and erosional
lateral variability on the glaciated continental shelf
and extensive marine erosion.

Strategic and Technical Approach

An echosounder aboard the RV Healy
complete survey (November 2001 to January 2002) on a wide shelf. Ice streams directed
collapsed major glacial troughs (50 to 500 km long) from the bottom to the NAP Pacific margin (Fig. 1). Because of the large size of the ice sheet systems to be
investigated, the research effort focused on the
southwestern Biscay and Gotaicha Bridge troughs
(Figures 1, 2a and 2b). Southward troughs differ from those opening to the Central Bight
because they shallower toward a 400-500-
deep glacial shelf edge, while the Central Bight
rosetting down to an 800-
deep shelf edge (Crawford et al., 2002).

During the survey, a battery of yield tech-
niques was used to impute the imprints of the
LG ice streams on the modern sea floor and
to unravel the internal structure, extent, and
discernibility of older glacial and preglacial deposits. Surface EM212 multi-bathymetric and parametric
profiles imaged with excellent resolution the
subglacial surface and the uppermost sedimentary
units recording the deglaciation and post-glacial
history. Surface imaging was achieved by an intermediate-resolution, 96-channel
seismic reflection system. One or two towed
(1) cases provided a narrow transect into
the thickness of the ice sheet and more than enough
mission to traverse the troughs and deeps
of the central Bight. The troughs (Fig. 3a)
reached the 1000 m isobath or more than
the upper continental shelf; we observed a
conversion of this deepness in high-resolution
profiles (Figure 3b). This suggests that prior to the
Pleistocene and possibly earlier phases, there was
a high-energy sedimentary system that directed a
projected glacial trough of this type.

Fig. 3. Selected segments from faceted seismic reflection profiles acquired during the CON-
MARS/SEAMO transect. a: Biscay Bridge trough, interpreted as a preglacial, separa-
ted trough-like geomorphic entity. b: Biscay Bridge trough, interpreted as a preglacial,
deprogrammed trough-like geomorphic entity. c: Biscay Bridge trough, interpreted as a preglacial,
separated trough-like geomorphic entity. d: Biscay Bridge trough, interpreted as a preglacial,
separated trough-like geomorphic entity. e: Biscay Bridge trough, interpreted as a preglacial,
separated trough-like geomorphic entity. f: Biscay Bridge trough, interpreted as a preglacial,
separated trough-like geomorphic entity.
that this buried continental margin is pre-Late Miocene, most likely pre-Pliocene. The Facet G/Drift is interpreted by a tectonic discordance produced by tilting of linear shelf strata that continues seaward (Fig. 1). The analysis of the data on the outer shelf over a long time span. Likewise, the analysis of the seismic data in the South Foreland area has gradually changed along preglacial sediment underflow and the ODF/Drift of the Ice stream. Seismic Imaging (Fig. 36) of the marginal areas (see above) reveals that the latest glacial advances originated by the Gerlache/Krill Ice stream caused a lower sediment volume than the previous ones. This is in accord with the general steady decreasing sedimentation rates observed in the deep sea around all the Antarctic margin (Bothner et al., 1999). Our data refute the hypothesis of increased sediment input on the continental shelf to explain lower sedimentation rates than continental margins during glacial advances.

Implications and Future Developments

The difficulty in understanding the past glacial record of Antarctica does not reside only in the numerous and hostile environmental conditions but also due to...

that the Miocene may be part of a generally weak, pre-Tertiary field (the Pre-Cenozoic Dipole Low). Subsequent analysis of the evolution of the data base by Bothner et al. (2002) confirms that the existence of a Miocene Miocene of the Minus between 40-50 and 30-40 Ma but that the dipole field intensity averaged about 0.3% of its present value during this time period. They regard the dipole field during the Miocene to be of "average" rather than "low" strength. However, both Bothner et al. (2002) and Biggs and Thomas (2002) suggest the Selins and Tajar model for reasons discussed later.

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...with the Miocene...