Gruppo Nazionale di Geofisica della Terra Solida

Atti del 40° Convegno Nazionale

27 - 29 GIUGNO 2022

TRIESTE - STAZIONE MARITTIMA

EAGE EUROPEAN ASSOCIATION OF GEOSCIENTISTS & ENGINEERS
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SEZIONE ITALIANA
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MIOCENE MOUNDS AT THE ROSS SEA PALEO-CONTINENTAL SHELF: EVIDENCE OF THE ONSET OF ANTARCTIC GLACIATIONS OR MUD VOLCANOES?

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Buried features, with the top lying between a few meters to 150 m below the seafloor, were identified, on high-resolution seismic reflections, in an area of about 257.5 km^2 in the southern Roosevelt Sub-basin, along the front of the Ross Ice Shelf (Antarctica), where the water depths is 700-900 m.

These features were interpreted as buried moraines deposited under marine conditions at water depth of several hundred meters, near the paleo-shelf edge and predating 25 Ma, thus placing the onset of the West Antarctic Ice Sheet (WAIS) growth and marine expansion in the late Oligocene (Sorlien *et al.,* 2007). Conversely Marschalek *et al.* (2021) suggest a much younger age for the WAIS based on the provenance of sediments at IODP site U1521, in the central-eastern Ross Sea.

Buried and modern, mound-shaped features with similar size and acoustic facies of those occurring in the Roosevelt Basin have been identified in the other sectors of the Ross Sea and interpreted as relict depositional/erosive structures formed by glacial advances and retreats (Perez *et al.*, 2021), but also as volcanic structures (Boehm *et al.*, 1993; Lawer e*et al.*, 2012), or mud volcanoes related to the occurrence of free gas and gas hydrates (Geletti and Busetti, 2011). Sedimentary mounds like those observed in the Ross Sea may have an accretion carbonate component, as observed in medium-low latitudes, also in cold regions (Wheeler *et al.*, 2005; Hovland, 2008; Somoza *et al.*, 2015), but they are strongly unlikely in an extreme polar environment which is thermodynamically unfavorable to calcifying organisms.

Unfortunately, although mounds are quite common in the Ross Sea, their origin is currently unknown, because they have never been directly sampled yet and their composition and age can only be inferred by their acoustic character.

This work presents new geophysical analyzes of the seismic reflection profiles across the buried Roosevelt Subbasin mounds to test previous hypotheses about their origin and formulate alternative explanation.

PSDM (Pre-Stack Depth Migration) of the seismic profiles allowed better definition of geometries and seismic velocities, mitigating pull-up effects. The processing steps allowed us to improve the signal-to-nose ratio, attenuate random noise and multiple reflections, improve temporal and spatial resolution, and define an accurate velocity field

The acoustic facies, velocity, size and shape of the buried features observed in the sediments filling the Roosevelt Subbasin are compared to those of the other Ross Sea mound provinces, by using published data (Geletti and Busetti, 2022, Bohem *et al.*, 1993) and by reprocessing the multichannel seismic profile BGR80-100 that intersects some circular-shaped, mounded features on the sea floor, along the continental slope and shelf near Cape Adare.

The seismic velocity of the mounds (~ 2800 m/s, Fig. 5), the chaotic internal facies and the strong amplitude reflector at their base are consistent with compacted, glacial material, which would support the hypothesis of Sorlien *et al.* (2007), who classify them as morainal structures.

However, the possibility that the structures do not have an elongated, but circular shape lead us to consider alternatives for the origin of the mounds.

The acoustic blanking observed beneath the mounds, interrupting the continuity of the reflectors may be indeed indicative of chimneys beneath the buried mounds within which upward migration of gas and fluids occurs along fractured and faulted sediments (e.g. Løseth *et al.*, 2009). This would explain the reflectors offset and upward bending (in depth migrated seismic profiles). Therefore we suggest the hypothesis that the mounds of the Roosevelt Subbasin formed as mud volcanoes instead of glacial moraines.

The age of the Roosevelt Subbasin mounds is inferred by indirect correlation and comparison with the eastern Ross Sea seismic sequences, after Brancolini *et al.* (1995) and the recent work by Perez *et al.* (2021), that improved the chronostratigraphic framework (after the IODP Exp 374, McKay, De Santis, Kulhanek *et al.*, 2019; Perez *et al.,* 2021).

The sea bed where the mounds grew is an erosional surface truncating with low angle a package of sub-horizontal reflectors, however it doesn't show glacial valleys incisions or other peculiar features suggesting deep erosion from grounding ice streams. The base of the mounds is possibly a transgressive marine surface, a residual, coarse sedimentary lag, swept by bottom currents, similar to the present day sea bed in the outer continental shelf. This would justify the strong amplitude of the reflector lying at the base of the mounds. The occurrence of current typical moat-sediments drifts within the mounds and the aggradational geometry of the strata infilling the depressions among the mounds would indicate open marine sediment deposition during a period of relative high sea level, during and after the mound formation.

The two hypothesis to explain the origin of the buried mounds in the Roosevelt Subbasin risen by Sorlien et al. (2017) and by our work, have implications for quite a diverse WAIS scenario, and confirming one of them with future shallow drilling would be very important for ice sheet volume and thermal rheology modelling reconstructions. The seismic profiles reprocessed for this work are used to locate drill sites and define targets of the IODP Pre-998 proposal (McKay, De Santis *et al.*, 2020).

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