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Submarine landslides in contourite drifts along the Pianosa Ridge (Northern Tyrrhenian Sea): A geotechnical approach.

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The Pianosa Ridge is a tectonic structure in the Northern Tyrrhenian Sea that forms the eastern flank of the Corsica trough (between Corsica and the Tuscan shelf). It is characterised by the presence of submarine landslides within the Pianosa Contourite Depositional System. Multibeam bathymetry, High-Resolution-72 channel (50-250 Hz) and CHIRP (3200-5200 Hz) seismic reflection profiles, collected during cruises PRISME2 and PRISME3 in 2013, revealed that bottom currents created a heterogeneous sedimentation pattern, resulting in zones of preferential deposition (drifts) and zones of erosion and/or non-deposition (moat and abraded surfaces). The sector where the largest submarine landslides took place is characterised by the presence of a plastered drift, a sediment body with a maximum thickness in the mid-low continental slope and a moat at the toe of the slope. Calypso piston cores and piezocone CPTu data acquired during the PRISME3 cruise in 2013 also provide valuable information about the lithology, geomechanical properties and stress history of contourite drifts and of the shallowest submarine landslide, named Pianosa Slump. Contourites in this area are mostly muddy, with coarser layers deposited during sea level falls. During sea level low-stands sedimentation rates (up to 115 cm•kyr-1 in the plastered drift) are higher than during sea level high-stands (20 cm•kyr-1 in the plastered drift). The plastered drift is underconsolidated with Overconsolidation Ratios (OCR) that range between 0.5 and 0.8. The Pianosa Slump formed in the plastered drift at 43-50 kyr BP has a volume of 2.62 km3, and it is covered by 17-20 m of sediment. The basal shear surface of the Pianosa Slump, at 30-56 m below the present-day seafloor, is correlated with a sediment layer characterised by the presence of zeolite minerals (up to 4% of sediment volume), high water content, low density, high compressibility, high permeability, high undrained shear strength and a post-peak strain softening behaviour.

The aim of this study is to understand the mechanical processes that control slope instability in a context of a contourite system by focusing on a plastered drift and by applying slope stability modelling, using the geotechnical data from cores and in situ measurements. 1D consolidation modelling with the SeCo software shows that the sedimentation rates found in the plastered drift during the last 150 kyr are not enough to generate significant overpressure. We propose that two factors probably favoured the instability of the plastered drift: 1) the geotechnical properties of the sediment layer containing zeolites, and 2) the presence of an incision (moat) created by bottom currents in the lower part of the plastered drift, generating locally a slope gradient up to 15°.