Geotechnical and geochemical investigations of the Marquês de Pombal landslide at the Portuguese continental margin

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Minning, M., Hebbeln, D., Hensen, C. & Kopf, A.: Geotechnical and geochemical investigations of the Marquês de pombal landslide at the Portuguese continental margin. *Norwegian Journal of Geology*, Vol. 86, pp. 187-198. Trondheim 2006, ISSN 029-196X.

The continental slope of the SW Portuguese continental margin is a geomorphologically diverse, tectonically active area with active faulting, canyon formation and mass wasting. Along the Marquês de Pombal fault (MPF), a submarine landslide was geophysically surveyed several years ago. Recently, five sediment cores from different parts of the landslide area were taken near its headwall, along its flow path, and at the distal lobe near the abyssal plain. At these cores, pore water chemistry and sediment physical properties such as index properties, grain size distribution, shear strength and frictional stability were measured. The most interesting results were found near the headwall and at the toe of the slide. The headwall sediment is characterised by low shear strength, high clay content, and an increase in shear strength when shear rate increases; velocity strengthening. The latter is usually expressed by a positive frictional response to a sudden change in sliding velocity (positive [a-b] values). These characteristics are all in favour of triggering slope failure and stable sliding behaviour. In contrast, the sediment at the toe of the slide show largely [a-b] values near zero or even negative, except one layer at 225 cm below seafloor that tends to velocity-strengthen. Interestingly, at this level pore water composition shows a profound deviation in many elements analysed, suggesting that the base of the most proximal portion of the slide was penetrated here. Modelling of geochemical deviation allows us to tentatively estimate deposition of this outermost lobe of remobilised sediment to 5 yrs. BP, which coincides with a regional M4.3 earthquake. We conclude, however, that this age corresponds to minor taper readjustments, while the main landslide event took place much earlier (see Vizcaino et al., this volume).

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Introduction

The inherent mechanisms and factors governing slope stability and submarine landslides are known because of extensive research carried out by academia and industry, however, the temporal and spatial variability of landslide processes remain poorly understood. In fact, the exact trigger mechanisms of only a few submarine landslides are known with certainty (Mienert et al. 2003). In general, submarine landslides occur due to an increase in loading on a sediment-laden slope, which may in turn lead to an increase in shear stress, or a reduction in shear strength. Possible trigger mechanisms for submarine landslides include sea level change, high sedimentation rates, oversteepening of the slope gradient, wave activity (especially during storm events), gas hydrate dissociation, pore pressure increase, tsunamis, and earthquakes.

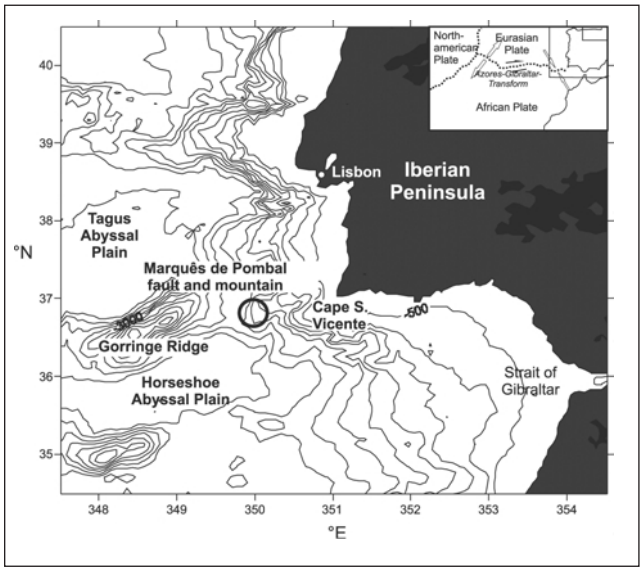

Fig 1: Location of the study area at the Iberian continental margin, southwest of Portugal. Small map in the top right-hand of the map shows the E-W-trending Azores-Gibraltar transform fault.

The region in the eastern North Atlantic southwest of the Iberian Peninsula was selected for this study (Fig. 1), because it comprises a geological setting where the interplay of many of the mentioned processes take place. It hosts the plate boundary between Eurasia and Africa, which is expressed as the Azores-Gibraltar transform fault. Smaller fault zones are located at the continental margin offshore Portugal, one of which is