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Sediment transport mechanisms inferred from heavy mineral assemblages on the 2010 Chilean tsunami deposit

João Cascalho (1), Pedro Costa (1), and Javier Lario (2)

(1) IDL and Departamento de Geologia, Faculdade de Ciências da Universidade de Lisboa. Campo Grande, Edifício C6-3 piso, 1749-016 Lisboa, Portugal., (2) Facultad de Ciencias, UNED-Universidad Nacional de Educación a Distancia, Senda del Rey, 9 – 28040, Madrid (España)

Characterization of heavy mineral (HM) assemblages in tsunami deposits has been applied to infer inundation and backwash phases and to establish sediment sources. In ideal conditions and due to their specific density (>2.9 g/cm3), heavy minerals are the most suitable component of a sediment assemblage that can provide information regarding flow competence. Having these features in consideration, sandy tsunamigenic samples from Arauco and Mataquito areas (central Chile) were retrieved after the 27th of February 2010 tsunami that affected the Chilean coastline.

Twenty seven samples (a total of 54 thin sections) tsunamigenic and beach samples were prepared to observe HM under the petrographic microscope. After dividing the samples in 4 fractions (<63 μm, 63- 125 μm, 125-500μm and >500 μm), HM were separated using bromoform and two fractions (63- 125 μm and 125-500μm) were individually mounted using Canada balsam resin on glass slides. About 300 heavy minerals per slide were identified and counted.

Both assemblages were mainly composed of magnetite, pyrrhotite, amphiboles, pyroxenes, olivine, micas and zircon (this specie particularly abundant in the finer fraction analyzed). In Arauco (Ar), average HM percentages in the 125-500 μm fraction was 17.9% while in Mataquito (Ma) it was 25.7%. In the 63-125 μm fraction HM average percentages were 36.9% and 56.1%, for Ar and Ma respectively. In the 125-500 μm fraction the percentage of magnetic minerals (the densest of the denser HM) correspond to 13.2% in Ar and 2.7% in Ma. While in the finer fraction these percentages are of 0.24% and 0.1%

In Ar it was possible to perceive that the highest concentration in HM and magnetic minerals was observed in the NE sector (Llico) of the embayment, where the highest run-up was observed. In this specific sector an inland decrease of HM and magnetic minerals was detected along a 300m profile, with HM percentages varying from 27% to 9% and magnetic minerals from 16% to 5%, thus suggesting a progressive energy decrease with inundation extent.

In Ma only an inland decrease in magnetic minerals was observed (in Lloca sector) with values decreasing from 4.9% to 2.5% with 175m. This also indicates a decrease in sediment transport competence by the incoming tsunami waves.

Here, the potential of HM is confirmed as a useful sedimentological tool to better understand tsunami events retrieving relevant information regarding to infer energy of tsunami waves.

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