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2010 Maule (Chile) and AD 1755 (Portugal) tsunami sediment samples: limitations of microtextural analysis

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The innovative application of microtextural analysis to the study of sandy tsunamigenic sediments has been sparsely attempted over recent years. Despite having demonstrated potential as a provenance tool, its reliability as a discriminant proxy for these deposits is still a matter under discussion. This is mainly due to the subjectivity of the analysis that heavily relies on operator proficiency but also to specificities of the data set (e.g. post-depositional dissolution masking other microtextures).
To address these issues, a double-blind simplified microtextural classification was tested by 3 independent observers, using more than 600 Scanning Electron Microscope images of sandy samples retrieved after the February 2010 Chilean tsunami. These were compared with approximately 15 AD 1755 tsunamigenic samples (app. 250 SEM images) retrieved from south Portugal. Comparison with a limited number of potential tsunami source sediment (beach and dune) was attempted to establish provenance relationships.
Grains were classified into four main microtextural families (A-fresh surfaces, B- percussion marks, C- dissolution and D- adhering particles) according to its most recent microtextural imprint (A to D) thus indicating the last event responsible for microtextural imprints.
In the Chilean samples the dominance of chemical marks (dissolution and adhering particles) was obvious. Combining these two microtextures, all samples presented results >69%. On the other hand, the Portuguese samples presented a much stronger presence of mechanical marks (e.g. percussion marks present up to 59%).
Reasons behind different results in the Chilean and Portuguese samples raise serious questions regarding the application of microtextural analysis to the study of tsunami deposits. Nevertheless, the discrepancies observed can also be explain by a one or a combination of the following factors: different geomorphological setting (with the presence of dunes in the Portuguese case), higher sediment concentration (in the Portuguese case), larger presence of offshore sediment (in the Chilean case), presence of pseudomorphic quartz (Chilean case), presence of primary-sourced glacial sediments (in the Chilean case) or differences in wave energy between the two events studied.
Results suggest that mechanical imprints are dominant in tsunamigenic samples from quartz dominated coastal environments. However, discrimination on the Chilean dataset was difficult and, in some cases, impossible whereas differentiation of the Portuguese tsunami deposits was relatively obvious.
Our work is currently addressing these hypothesis to determine the relevance of this sedimentological technique as a provenance tool despite the observed site-specific constraints that limits its straightforward application to tsunami deposits.
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