EGU2020-8826
https://doi.org/10.5194/egusphere-egu2020-8826
EGU General Assembly 2020

Diffraction imaging to understand the internal fabric of mass-transport complexes from Gulf of Cadiz, south west Iberian Margin

Jonathan Ford[1,2], Roger Urgeles[3], Eulàlia Gràcia[3], and Angelo Camerlenghi[1]
[1]Istituto Nazionale di Oceanografia e di Geofisica Sperimentale (OGS), Sgonico (Trieste), Italy (jford@inogs.it)
[2]Università degli Studi di Trieste, Trieste, Italy
[3]Institut de Ciències del Mar, Barcelona, Spain

Outcrop examples of mass-transport complexes (MTCs) often show a complex internal fabric which reflects disaggregation, deformation and entrainment that occurred during transport and emplacement. This can include intense folding, included blocks of substratum and internal shear zones. Seismic reflection images often cannot properly image this internal fabric as the scale of such structure is usually below the effective resolution. This can limit seismic interpretation to characterising only the overall morphology of the deposits (the top and basal reflectors).

Seismic reflections are primarily generated by smooth, laterally continuous interfaces. Discontinuities at or below the scale of the seismic wavelength instead generate seismic diffractions ("diffraction hyperbolae" in unmigrated images). Diffractions are often ignored during seismic processing as they are generally lower in amplitude than reflections, though they do not suffer from the same lateral resolution limit as reflections so are potentially sensitive to smaller scale structure. We suggest that the discontinuous internal fabric of MTCs will generate a significant amount of diffraction energy relative to unfailed sediments.

The main goal of this study is to use diffraction imaging to image the small-scale, heterogeneous internal fabric of MTCs. We demonstrate this using two high-resolution, multi-channel 2-D marine seismic profiles (3.125 m CMP spacing, 500 m maximum offset) acquired in 2018 and 2019 as part of the INSIGHT project to investigate submarine geohazards in the Gulf of Cadiz. Profile 1 intersects the Marques de Pombal reverse fault and shows a series of stacked MTCs (~1 s TWTT from top to bottom) in the footwall, thought to be related to episodic fault activity. Profile 2 is located in the Portimão Bank area and contains two large MTCs thought to be related to the mobilisation of a salt diapir. The diffraction imaging method proceeds as i) dip-guided plane-wave destruction to separate reflected and diffracted wavefields; ii) velocity analysis by cascaded constant velocity migrations of the diffraction wavefield; iii) post-stack Kirchhoff time migration of the diffraction wavefield.

The unmigrated profiles show that the MTC bodies do generate more internal diffractions than the surrounding unfailed sediments. We also observe large contributions of diffraction energy from the rugose top and base of the MTCs, the rugose top salt interface and from faults within the unfailed sediments. The migrated diffraction images reveal distinct internal structure, thought to

represent rafted blocks, ramps and both extensional and compressional faulting. The envelope of the diffraction image is used as an overlay on the conventional reflection image to guide interpretation and highlight potential diffractors. This allows interpretation of thin MTCs and improved delineation of their lateral extent (runout) above conventional reflection images.

Diffraction imaging has previously been used to image heterogeneous geology such as fracture networks, channel systems and karst topography. Here we apply the technique to study the internal fabric of MTCs. The resulting images resolve small-scale internal structure that is not well resolved by conventional reflection images. Such structures can be used as kinematic indicators to constrain flow direction and emplacement dynamics, which inform the geohazard potential of future subaqueous mass-movements.