High-Resolution 3D seismic imaging of the Utu Uli Mn-Ni deposit

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Seismic imaging of volcanic complex is by far one of the most challenging target of marine seismic surveys: 1/ 3D seismic acquisition and imaging process are required to properly focus reflections whereas 2D seismic imaging is unreachable because of 3D diffractions. 2/ Seismic imaging is highly sensitive to the structures dips where volcanoes often display dips greater than 15°. 3/ Strong impedance contrasts, linked to the alternation of volcanoclastic and in place volcanic rocks required an optimal control of seismic amplitudes.

In spite of these limitations, the volcanic complex of Utu Uli located on the northern edge of the Futuna ridge was tentatively surveyed, as it hosts remarkable features such as well preserved structures, interbedded relatively continuous volcaniclastic deposits, pillow lavas and a unique hydrothermal Mn(-Ni) deposit. The High-Resolution 3D survey allowed to successfully image the internal structure of this complex of volcanoes up to several hundred metres thick. The 21-km^2 seismic survey was shot using a dual streamers - dual source (single air gun) with a 110 Hz dominant frequency [1]. The dense and homogenous coverage of the area by 180 seismic lines during 9 days of acquisition allows to take advantage of 3D imaging techniques. The resulting seismic volume has a vertical resolution lower than 3 metres and a horizontal resolution lower than 25 metres. The first seismic attributes extracted from the 3D processed data display high amplitude contrasts related to high reflectivity seismic facies. The main seismic units observed on the 3D seismic volume likely correspond to: (i) layered pyroclastic-fall deposits and (ii) shallow intrusions and/or interbedded pillow lavas. Interistingly, magmatic bodies occur just beneath and/or surround the most altered and mineralized zone of the Utu Uli Mn-Ni deposit and thus might be a credible heat source of the hydrothermal system.

[1] Thomas *et al*. (2012) *Near Surf. Geophys*., **10**(**4**), 291-301.