

Using the IODP Expedition 312 Vertical Seismic Profile to Investigate Sub-basement Reflections in Multi-Channel Profiles

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Abstract

The Ocean Drilling Program (ODP) initiated drilling at Site 1256D in the Guatemala Basin, about 1000km off the East Pacific Rise to penetrate plutonic rocks, anticipated to be relatively shallow in this region formed at an ultra-fast spreading rate. IODP Expedition E312 successfully drilled into gabbros at ~ 1150m in basement. Multi-channel seismic traces, although not processed for the purpose, show weak laterally-coherent sub-basement reflections at borehole depths (Hallenborg et. al., *Journal of Geophysical Research*, Vol 108 No. B11, 2532, 2003). Synthetic reflectivity seismograms were computed using a Ricker wavelet and impedance profiles from borehole sonic logs. They strongly suggest the presence of significant sub-basement amplitude peaks – although attenuation has not been modeled. Zero-offset vertical seismic profiles were processed to investigate the authenticity of these reflections and interpret the geological features that caused them. A dual scheme of the median filtering and F-K dip filtering was used. Down-going energy is clearly identified but negligible up-going energy is visible over random noise. The absence of geophones above the basement prevents comparison of basement reflections with sub-basement ones, so that a critical energy level above the noise could be established to identify up-going energy. The negative results are consistent with the topography of geological horizons on horizontal scales less than the Fresnel Zone (~300m). This expedition is the first penetration through volcanic extrusives and dikes into plutonic basement. In such a setting, sub-basement reflections, if present, would have been accurately measured. Absence of such clear and comprehensible observations in this area strongly suggests that lava flows and igneous contacts in upper ocean crust have significant topography on lateral scales <300 m due to igneous and tectonic processes.