SUPPLEMENTAL MATERIAL

Figure S1. Location of two crossing seismic Lines that intersect at IODP Site U1438. Background bathymetry from the GMRT (Global Multi-Resolution Topography)data set of Ryan et al. (2019).

Figure S2. A Raw time-migrated multi-channel seismic line D98-A from common depth point (CDP) 31328 to 34928. Horizontal axis is CDP number and vertical axis is two-way travel time (TWT) in seconds. Location of IDOP Site U1438 shown as the black vertical bar. B. The interpreted seismic lines shown as solid black lines, dotted where uncertain. See Figure S1 for location of line. The seismic data were acquired by Japan National Oil Corporation in 1998 and are archived at JAMSTEC.

Figure S3. A Raw time-migrated multi-channel seismic line D98-8 from common depth point (CDP) 39932 to 42832. Horizontal axis is CDP number and vertical axis is two-way travel time (TWT) in seconds. Location of IDOP Site U1438 shown as the black vertical bar. B. The interpreted seismic lines shown as solid black lines, dotted where uncertain. See Figure S1 for location of line.

Figure S4. Unpublished maps (bathymetry and backscatter) created by Jim Gardner in conjunction with his 2010 publication (Gardner pers. commun, 2017). He interprets the backscatter images as showing that the channels leading out of the central part of the ridge have a higher backscatter than the adjacent seafloor, probably clay-rich abyssal sediment; this is to be expected if the sediments in the channel are basalt debris from the seamounts of the ridge.  The CHIRP subbottom profiler line in Gardner (2010) has a highly reflective surface in the channel compared to the pelagic sediment outside the channel but the sediment at the end of the channels was not resolved in his bathymetry or backscatter data.

Supplemental Material References

Gardner, J.V., 2010, The West Mariana Ridge, western Pacific Ocean: Geomorphology and processes from new multibeam data: GSA Bulletin, v. 122; no. 9/10; p. 1378–1388; doi: 10.1130/B30149.1

Ryan, W. B. F., et al. (2009), Global Multi‐Resolution Topography synthesis, *Geochem. Geophys. Geosyst.*, 10, Q03014, doi:[10.1029/2008GC002332](https://doi-org.clsproxy.library.caltech.edu/10.1029/2008GC002332).