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Expressions of fluid venting on the continental slope offshore Nicaragua imaged with sidescan sonar and sediment echosounder

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Fluid venting on the middle continental slope of the Central American subduction zone causes several morphological and lithological expressions on the seafloor. In an area of approximately 700 km^2, ranging in water depth from 800 to 2400 metres, 46 mound structures or anomalies in backscatter intensity have been mapped with multibeam bathymetry, 75 kHz deep-towed side-scan sonar and 2-10 kHz Chirp subbottom profiler. The features showing a morphological expression can be classified into three types of 'mound' structures. (1) The 'dome-' or 'knoll-like' mounds have a circular base as well as steep downslope and flat upslope flanks. The flat top areas show high backscatter intensity that is probably caused by carbonates. In many cases vent fauna has been observed together with occasional depressions in the top area that are interpreted as slumps. The mounds are 700 to 1000 metres wide and 50 to 100 metres high. (2) The second type has only little topographic relief but shows strong anomalies in backscatter intensity. Subbottom profiler data show partial sediment coverage of the mounds. The shape of these backscatter intensity anomalies is irregular with diameters not exceeding 500 metres. Here high backscatter is probably also caused by carbonates. Vent fauna is abundant. (3) The third type consists of large, massive and probably older, now inactive mounds, because they show an eroded topography. They show massive, fractured carbonates but only few indications of active fluid venting. Their diameters can exceed 1000 metres and they are up to 150 metres high. In addition features without morphology but strong backscatter anomalies are observed in 75 kHz sidescan sonar data. A distinction is made between very high backscatter anomalies with diameters of 100 to 200 metres and irregular outlines and diffuse spots

with backscatter intensity that is only slightly increased over the surrounding area. We speculate that these diffuse spots may indicate gas-hydrates or carbonates in the shallow subsurface. Some mounds are concentrated around the upslope limit of larger slump scars. These mounds therefore could indicate the presence of conduits caused by slope failure resulting from seamount subduction. Other mounds are aligned on ridges crossing the slope. These ridges are probably caused by fluid seepage along faults. The height of these ridges is further increased by erosion in the neighbouring canyons. To separate the effects of slope and lithology on backscatter intensity and to estimate the amount of authigenic carbonates on the seafloor, the backscatter intensity values are normalized with respect to the incidence angle. The result is then compared to the original sidescan image. The formation mechanism of the mound structures and the intensity anomalies is believed to result from the interplay of upward migrating fluids, precipitation of authigenic carbonates and various degrees of submarine erosion.