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# GIS modeling of gas hydrate stability along the continental margin of Gulf of Cadiz: influence of focused fluid migration and Mediterranean undercurrents

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A predictive geographical information system (GIS) model for mapping the regional 3D distribution in which seafloor gas hydrates would be stable is presented. The GIS model has been developed for the northernmost continental slope of the Gulf of Cadiz, an area where an abundant supply for hydrate formation, such as extensive hydrocarbon seeps, diapirs and fault structures, is combined with deep undercurrents and a complex seafloor morphology. The first step is to construct digital terrain models (DTMs) for depth-pressure, geothermal gradient and bottom water temperature variables, based on 3D data of bottom water temperatures, swath bathymetry, sub-seafloor temperature gradients and gas compositions. The second step is to calculate the gas hydrate equilibrium functions for the various hydrocarbon compositions reported from hydrate and sediment samples. A further step is the calculation of the base of the hydrate stability zone, assuming these 3D functions for each grid point. It is solved as a transcendental function by means of a GIS algorithm. The final predictive GIS model depicts the distribution of the base of the gas hydrate stability zone for both biogenic and thermogenic gas compositions, and explains the geometry and distribution of geological structures derived from gas venting in the Tasyo Field (Gulf of Cadiz) and the

generation of BSR levels on the upper continental slope in the Gulf of Cadiz.

In the Gulf of Cádiz, theoretical HSZ shows a sharp, thinning link with the seafloor area warmed by Mediterranean Outflow Water (MOW). This area shows a critical equilibrium very sensitive to sea-level and warm-current changes and it is here where we have detected the biggest density of pockmarks, mud volcanoes and slumps over the slope of continental margin (Leon et al., 2006). Gas hydrates dissociation structures present a close relationship with the theoretical depth of the base of HSZ; so that this level matches with the base of the pockmarks and detach level of slumps. Applications of the proposed model are: a) potential mapping of seafloor HSZ, b) estimation of hydrate reserves, c) mapping of potential hazards triggered by gas hydrate dissociation.