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Sedimentological and Mineralogical Characterization of Gas Hydrate Bearing Sediments from ODP-Leg 204, Southern Hydrate Ridge (Cascadia Margin)

E. Piñero (1), E. Gràcia (1), F. Martínez-Ruiz (2), J.C. Larrasoaña (3), A. Vizcaino (1), G. Ercilla (4)

(1) Unitat de Tecnologia Marina - CSIC, Barcelona, Spain, (2) Instituto Andaluz de Ciencias de la Tierra - CSIC, Granada, Spain, (3) Institut de Ciències de la Terra "Jaume Almera" - CSIC, Barcelona, Spain, (4) Institut de Ciències del Mar - CSIC, Barcelona, Spain (epinero@utm.csic.es / Phone: +34932309500)

During Leg 204 of the ODP "Drilling gas hydrates in Hydrate Ridge" 9 sites (1244 to 1252) were drilled in the southern Hydrate Ridge (SHR), on the Cascadia accretionary complex. In order to characterize the texture and chemical composition of Quaternary sediments and evaluate their role in the occurrence of gas hydrates, we have conducted sedimentological and geochemical analyses of more than 300 samples. The analyses performed include grain-size distribution, $CaCO_3$, TOC and S contents, sand fraction composition and clay and bulk mineralogy, from seven sites grouped into three environments: the summit (Sites 1249 and 1250), the east flank (Sites 1244 and 1246) and the west flank (Sites 1245, 1247 and 1248) of SHR. The sedimentology results allow the characterisation of the main depositional facies present at the SHR, which comprise hemipelagic, turbidites, ash layers and debris flow deposits. In addition, secondary facies, such as soupy, mousselike and flaky textures have been also identified in sediments resulting from gas hydrates dissociation. The sediments consist mainly of hemipelagic silty clays (50-60% clay, 40-45% silt, 0-5% sand) with a mean grain-size diameter of 8.4ϕ and poorly sorted (S.D.$<$2). Some graded silt layers have been identified, with up to 25% sand and high magnetic susceptibility values, interpreted as turbidite events. They are more common at the SHR flanks than in the summit, where gas hydrates are more abundant (up to 10%) (*Trehu et al., 2004*). Horizon A is a turbidite layer first identified on multi-channel seismic reflection data and it is predominantly composed by volcanic ash. It has been suggested that this Horizon may act

as a conduct favouring gas migration from deep in the accretionary complex to near surface gas hydrate deposits. The total carbonate content of the sediments is 4-9%, although locally reaches up to 15-25% associated to near surface authigenic carbonates, which are generated by bacterial sulfate reduction of methane-rich fluids. The TOC contents in the summit sites are low and homogeneous ranging from 0.83% to 1.51%, whereas on the west flank of SHR they range from 0.24% to 2.1%, with the lowest values found on the ash layers. The S content on SHR sediments is low, reaching up to 0.8%. The exception is a silty clay sample in the west flank with a maximum S content of 3.3%, which correlates to a large peak in magnetic susceptibility record ($> 140*10^{-8}$ m^3/Kg). The sampled interval corresponds to a 10 cm long magnetic sulfide (pyrrhotite) vein oblique to the stratification, probably associated with upward fluid flow migration. Regarding sediment composition, bulk and clay mineralogy does not change significantly from the summit to the flanks of southern Hydrate Ridge. Bulk mineralogy is dominated by clays (30 to 60%), quartz (25 to 40%), feldspars (10 to 25%) and minor amounts of calcite. The most abundant mineral in the clay mineral associations is detrital mica averaging 50%, smectites, kaolinite and chlorite are less abundant and range from 10 to 30%. Some noticeable trends are recognized in smectite abundance with depth, increasing its content below the BSR. In conclusion, gas hydrate distribution in SHR does not seem to be directly related to the presence of coarse grained layers, although they may act as conducts for the methane-rich fluids from the deep to near surface gas hydrate deposits.

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