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Drilling Gas Hydrate at Hydrate Ridge, ODP Leg 204

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Abstract:
Gas hydrates are ice-like compounds that form at the low temperature and high pressure conditions common in shallow marine sediments at water depths greater than 300-500 m when concentrations of methane and other hydrocarbon gases exceed saturation. Estimates of the total mass of methane carbon that resides in this reservoir vary widely. While there is general agreement that gas hydrate is a significant component of the global near-surface carbon budget, there is considerable controversy about whether it has the potential to be a major source of fossil fuel in the future and whether periods of global climate change in the past can be attributed to destabilization of this reservoir. Also essentially unknown is the interaction between gas hydrate and the subsurface biosphere. ODP Leg 204 was designed to address these questions by determining the distribution, amount and rate of formation of gas hydrate within an accretionary ridge and adjacent basin and the sources of gas for forming hydrate. Additional objectives included identification of geologic proxies for past gas hydrate occurrence and calibration of remote sensing techniques to quantify the in situ amount of gas hydrate that can be used to improve estimates where no boreholes exist. Leg 204 also provided an opportunity to test several new techniques for sampling, preserving and measuring gas hydrates.

During ODP Leg 204, nine sites were drilled and cored on southern Hydrate Ridge, a topographic high in the accretionary complex of the Cascadia subduction zone, located approximately 80 km west of Newport, Oregon. Previous studies of southern Hydrate Ridge had documented the presence of seafloor gas vents, outcrops of massive gas hydrate, and a pinnacle" of authigenic carbonate near the summit. Deep-towed sidescan data show an approximately 300 x 500 m area of relatively high acoustic backscatter that indicates the extent of seafloor venting. Elsewhere on southern Hydrate Ridge, the seafloor is covered with low reflectivity sediment, but the presence of a regional bottom-simulating seismic reflection (BSR) suggests that gas hydrate is widespread.

The sites that were drilled and cored during ODP Leg 204 can be grouped into three end-member environments basedon the seismic data. Sites 1244 through 1247 characterize the flanks of southern Hydrate Ridge. Sites 1248-1250 characterize the summit in the region of active seafloor venting. Sites 1251 and 1252 characterize the slope basin east of Hydrate Ridge, which is a region of rapid sedimentation, in contrast to the erosional environment of Hydrate Ridge. Site 1252 was located on the flank of a secondary anticline and is the only site where no BSR is observed.

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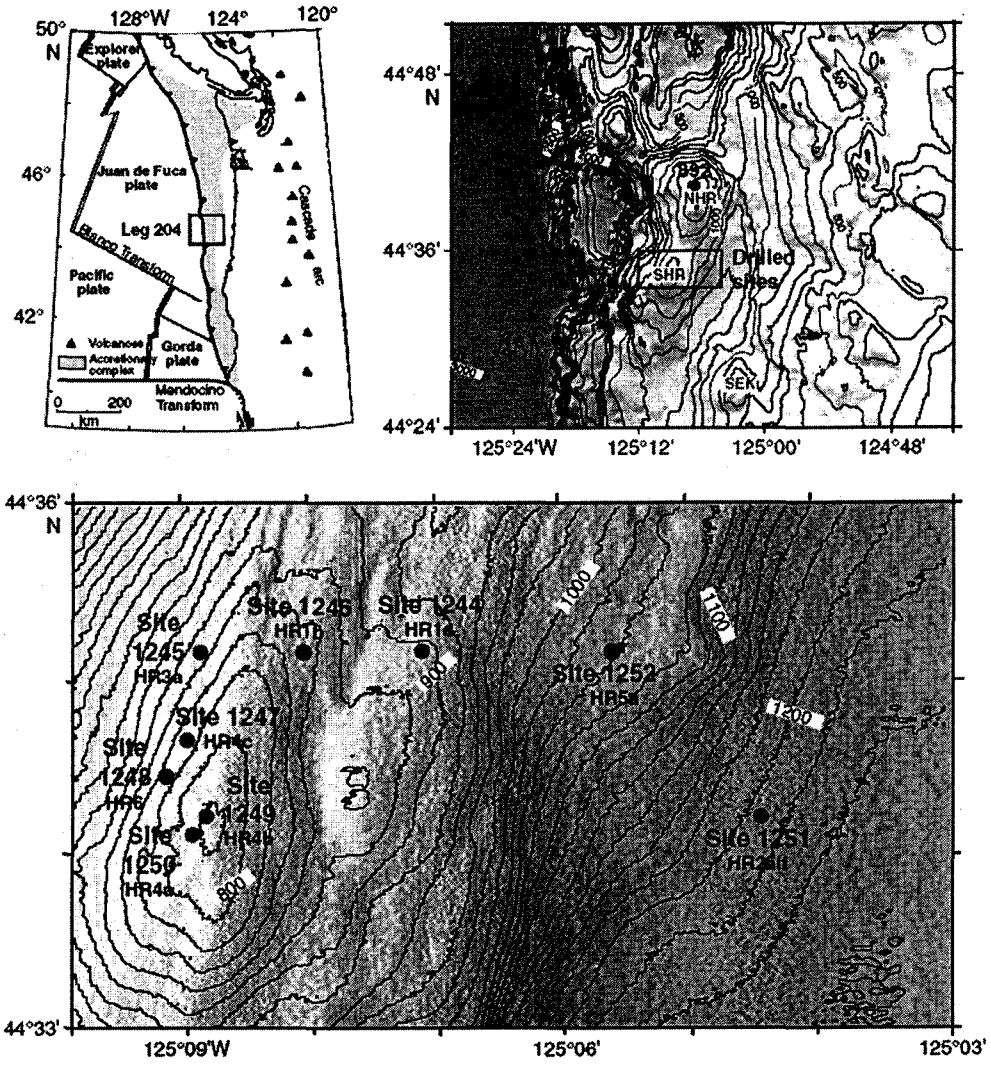

Fig. 1. A. Tectonic setting of Leg 204 in the Cascadia subduction zone. B Bathymetric map of the study area. C. Sampling Location of the Leg 204 Sites.

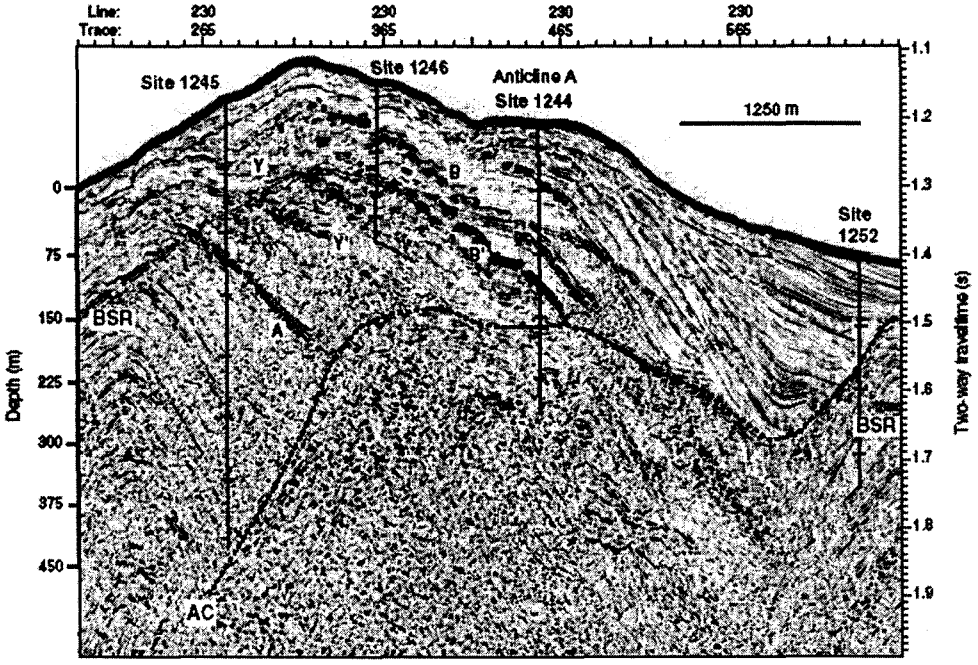

Fig. 2. East-west vertical slice the 3-D seismic data.

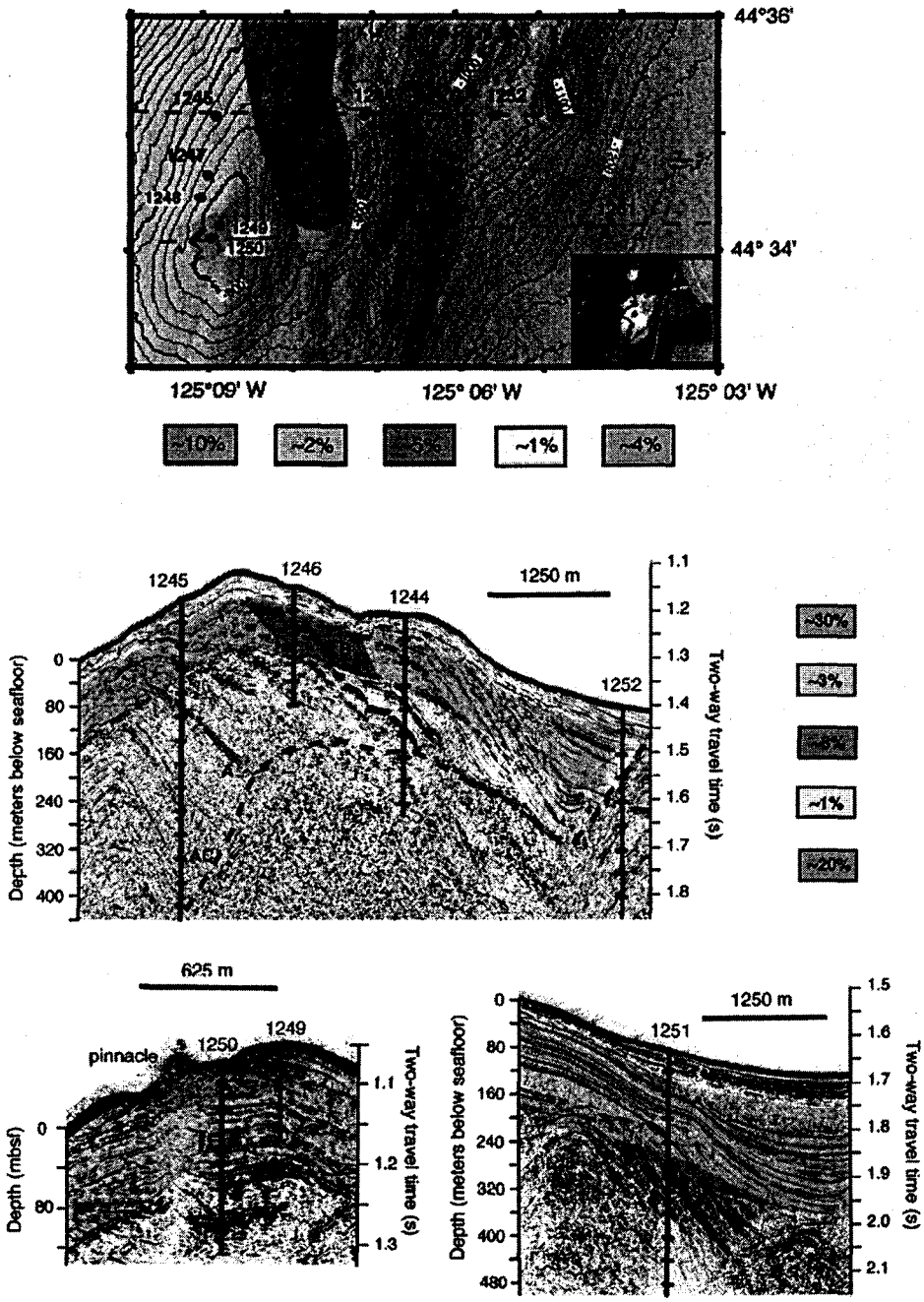

Fig. 3. 3-D distribution of gas hydrate concentration, Hydrate Ridge.