Is there is a connection between Subduction Zone Earthquakes, submarine landslides, and the Destabilization of Gas Hydrate on the central Oregon Margin?

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Current gas hydrate research is focused on the physical, chemical, and biological aspects of gas hydrate systems, the dynamics of gas hydrate stabilization, and perhaps more importantly, factors that influence their destabilization. Although, there are several sedimentological and geochemical mechanisms believed to influence the stability of gas hydrate systems on continental margins worldwide, the influence of the great earthquake cycle on the destabilization of gas hydrate systems in active margin settings is unknown. Current examininaton of the interaction between recurrent subduction zone earthquakes, submarine landslides, and gas hydrates on the Cascadia accretionary prism suggests linkages independent of climatologic factors. Hydrate Ridge, a well-studied gas hydrate province offshore central Oregon, is an ideal location to determine this interaction because it lies within a portion of the margin that has a well constrained Holocene paleoseismic record of great subduction zone earthquakes and contains a record of Holocene submarine landslide deposits derived from the ridge.

Core data from the basin west of this ridge contain a record of cyclic turbidites similar to that recorded on the Cascadia abyssal plain, suggesting that denudation of the ridge, and thus destabilization of the hydrate system by submarine landsliding may be controlled by the subduction zone earthquake cycle (Johnson et al., 2001; 2002). The great earthquake cycle in Cascadia over the past 10,000 years is now known via margin wide correlation of turbidite events and testing of alternative turbidite triggers (Goldfinger et al., 2001; 2002). To evaluate the link between earthquakes and landslides on Hydrate Ridge, we will collect new piston cores from Hydrate Ridge Basin-West (HRB-W) and use AMS radiocarbon techniques to establish Holocene datums throughout the cores. These data will help to identify the occurrence, distribution, and recurrence interval for Holocene submarine landslides derived from Hydrate Ridge. Comparison of this record with the Holocene subduction zone earthquake record, from abyssal plain turbidites, will then help determine the influence of subduction zone earthquakes on submarine landslides on Hydrate Ridge. We postulate that earthquake-triggered submarine landslides are a dominant mechanism that could have a short-term recurrent effect on the destabilization of gas hydrate in an active margin setting. Alternatively, denudation of the ridge and subsequent destabilization of gas hydrate may be controlled by both earthquakes and additional processes such as rapid fluid expulsion or degassing of the ridge driven by local deformation. Regardless of the landslide trigger, establishing the frequency of the submarine landslides derived from the ridge is the first step in identifying the influence of margin-wide tectonic processes on the stability of slopes and gas hydrates on an active margin.

On a larger scale, mega-landslides identified on the Oregon margin and other localities may also serve as a vehicle for injection of massive amounts of methane into the water column, and thus the atmosphere, on a less frequent basis. The great Oregon slides most likely have little to do with climate change, as they are deep seated, and most likely related to tectonic factors such as seamount subduction. They do however represent catastrophic tectonically driven events that destabilized large tracts of seafloor, and most likely introduced large volumes of both hydrate and free gas into the water column.