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Holocene Earthquakes, Slope Failures, and Submarine Gas Hydrates at Hydrate Ridge, Cascadia Margin

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Abstract

Hydrate Ridge Basin West (HRB-W) is an isolated slope basin located down slope of the well-studied gas hydrate-bearing Hydrate Ridge anticline on the lower slope of the Oregon accretionary wedge. Swath bathymetry and high-resolution sidescan sonar imagery indicate the western flank of Hydrate Ridge is dissected by a large submarine canyon, which serves as the major pathway for sediment transport into the basin. Two piston and companion trigger cores and one 10 ft super kasten core were recently collected from the basin to obtain the Holocene record of slope failure sedimentation events (turbidites/debris flows). To determine the frequency of these slope failures, their temporal effect on seafloor gas hydrate destabilization on Hydrate Ridge, and differentiate between possible triggers responsible for their failure, we compare this slope basin record to the margin-wide earthquake triggered submarine canyon turbidite record preserved in 52 piston and box cores collected in 1999. AMS radiocarbon dating of the submarine canyon turbidites and their margin-wide correlation indicate 13 events have been simultaneously triggered from the Washington to Northern California margins since the eruption of Mt. Mazama 7627 +/-150 cal yr B.P (Zdanowicz et al., 1999) and 18 (5 pre-Mazama -13 post-Mazama) have been simultaneously triggered during the last 10,000 years. We believe the most likely trigger for these events is recurrent subduction zone earthquakes. Initial examination of the new HRB-W cores suggests a possible correlation with the margin-wide turbidite record,

with ~20 events occurring above a foraminiferan dominant to radiolarian dominant datum, which can be used as a proxy for the onset of Holocene sedimentation. Planned AMS radiocarbon dating of all events in the new cores will provide more precise ages and test for synchronicity with the margin-wide record. We postulate that earthquake-triggered slope failures are a dominant mechanism that could have a short-term recurrent effect on hydrates in an active margin setting. Alternatively, a partial correlation to the earthquake record might suggest 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.

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