Cite abstracts as **Author(s) (2010), Title, Abstract xxxxx-xxxx presented at 2010 Fall Meeting, AGU, San Francisco, Calif., 13-17 Dec.**

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0800h
OS21C-1515 *Poster*

Melt anomalies and propagating ridge offsets: Insights from the East Pacific Rise and Juan de Fuca Ridge

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Recent observations of crustal structure associated with propagating ridge offsets at both the Endeavour and East Pacific Rise (EPR) ISS indicate local crustal thickness anomalies are associated with propagating ridge tips and renew the question of the role of melt anomalies in driving ridge propagation. Seismic and gravity data from the flanks of the Endeavour and adjoining segments of the Juan de Fuca Ridge reveal a 10-20 km wide zone of thicker and possibly denser crust on the young crust side of pseudofaults left by former propagating offsets. A sequence of bright ridge-ward dipping sub-Moho seismic reflections underlie the region of thicker crust and are interpreted as frozen magma sills at the base of the crust emplaced behind the propagating ridge tips [Nedimovic et al., 2005]. Crust within the pseudofault zones is denser and the presence of iron-enriched compositions is inferred, with the sub-crust magma sills the presumed source magma bodies for these denser, iron-enriched crustal rocks. Comparisons with the well-studied overlapping spreading center discontinuity at the EPR 9°03'N reveals a similar suite of crustal anomalies. On the flanks of this southward propagating discontinuity, an ~20 km wide band of crust that is both thicker and denser is located behind the V-shaped discordant zone of the OSC [Canales et al., 2002; Toomey and Hooft, 2008]. A broad swath of higher crustal magnetizations encompasses the region of thicker and denser crust as well as the adjoining discordant zone of relict OSC ridge tips and overlap basins [Carbotte and Macdonald, 1992]. At the southern edge of the band of thick crust, Singh et al. [2008] find evidence for a large melt anomaly in the lower crust and anomalously thick crust at the propagating eastern ridge of the OSC. The presence of local melt accumulations inferred from these bands of thicker crust behind propagating ridge offsets at both EPR and Juan de Fuca, presumably contributes to the forces driving ridge propagation in these regions. These excess melt accumulations may reflect presence of

small shallow mantle melt anomalies that persist as discrete anomalies while migrating along-axis behind the propagating ridge tip. Alternatively, as the propagating ridge tip advances into colder preexisting lithosphere, damming and accumulation of melts due to the strongly 3D topography at the base of the lithosphere may be important.

[3035] MARINE GEOLOGY AND GEOPHYSICS / Midocean ridge processes

[3040] MARINE GEOLOGY AND GEOPHYSICS / Plate tectonics

[8150] TECTONOPHYSICS / Plate boundary: general

Ocean Sciences (OS)

2010 Fall Meeting
