Integrated 2D geophysical modeling over the Juan de Fuca plate

Asif Ashraf*, Irina Filina

University of Nebraska-Lincoln

Out of three oceanic plates subducting beneath North America along the Cascadia Subduction Zone, the Juan de Fuca (JdF) plate is the most intriguing one as it has an unusual seismicity pattern. The two other plates – the Explorer to the north and the Gorda to the south – are associated with a large number of earthquakes along the subduction zone. In contrast, JdF is seismically quiescent, so the inevitable and potentially devastating megathrust earthquake is expected in that region. To understand the tectonic complexity of the JdF subduction, it is important to understand the overall crustal architecture of the margin as well as to know physical properties (densities and magnetic susceptibilities) of the rocks of both oceanic and continental domains. Hence, we performed 2D integrated geophysical modeling along a published seismic reflection profile spanning from the Juan de Fuca spreading ridge to the High Cascades onshore.

In our analysis, we have integrated multiple geophysical data from public sources, namely gravity and magnetic fields with seismic reflections and refractions. Our constructed 2D geophysical model starts from the Axial segment of the JdF spreading ridge. On the western side of the profile, gravity model requires lower densities of the mantle rocks associated with the Cobb hotspot. There are also two bathymetric seamounts near the oceanic ridge that have both gravity and magnetic signatures. Our profile crosses the pseudofault zones that require lower crustal densities with respect to adjacent oceanic crusts. We interpret this as evidence of extensive faulting in that region making the pseudofaults zones of weakness within the JdF plate. Our modeling also suggests the presence of a buried seamount beneath the accretionary prism that appears to be in contact with the Siletz terrane of the continental domain. This buried seamount may potentially influence the overall subduction process and may be related to the lack of earthquakes in this region.