Major tectonic features of the Juan de Fuca and Gorda plates mapped from spatial analysis of potential fields

Asif Ashraf*, Irina Filina
University of Nebraska-Lincoln

Cascadia subduction zone has a high potential for an inevitable and devastating megathrust earthquake. This margin has a complex earthquake pattern as a seismically quiescent zone along the coast of Oregon bounded by seismically active regions to the north and south. This pattern may be related to variations in the tectonic features of the subducting Juan de Fuca and Gorda plates. The primary objective of this project is to map major tectonic structures of these oceanic plates using a joint analysis of gravity and magnetic fields constrained with available seismic reflection and refraction profiles.

Two prominent tectonic features on the Juan de Fuca and Gorda plates are pseudofaults and seamounts. Pseudofaults are traditionally traced based on the offsets in magnetic isochrones, while some of the seamounts are evident in bathymetry. In our study, we use a joint spatial analysis of gravity and magnetic fields to map both types of tectonic structures more confidently. Before filtering, we apply a series of necessary corrections, such as Bouguer correction in gravity and reduction to the pole in magnetic field. After removal of regional trends, a series of filters are applied to the residual gravity and magnetic anomalies to further highlight the signatures of shallow tectonic structures.

Our analysis suggests that pseudofaults are not always associated with significant offsets in magnetic lineaments. The magnetic reversals mask the signature of seamounts, so they are challenging to locate confidently from the magnetic field alone. In contrast, they have a characteristic gravity signature that allows confident mapping, even those not evident in bathymetry. We use several published seismic reflection and refraction profiles to validate our mapped tectonic structures. We noticed the apparent correlation between identified seamounts and interpreted pseudofault zones. The integration of several geophysical datasets results in a more confident interpretation of pseudofaults and seamounts over both Juan de Fuca and Gorda plates. The next stage of our project is to investigate a possible correlation of interpreted tectonic features with the observed seismicity pattern in order to test their influence on the subduction process.