Shock Filter: A Powerful Tool to Map Basement Blocks and Faults in the Peace River Arch of Alberta Based on Magnetic Signatures

Hassan H. Hassan[1] and Janine Weber[2]
[1]*Fugro Gravity & Magnetic Services, Inc., Calgary, Alberta, Canada*
[2]*Fugro Gravity & Magnetic Services, Inc., Houston, Texas, USA*

Abstract

Spatial magnetic discontinuities displayed on aeromagnetic images often correspond to subsurface structural features such as basement blocks and their bounding faults. Their detection is of utmost importance stage in interpreting aeromagnetic maps because they have significant impact on oil and gas exploration. This abstract introduces a relatively new filtering technique to enhance these basement features known as 'shock filtering'. Shock filtering enhanced the signature made by basement blocks and their bounding faults on aeromagnetic images. This filtering technique is based on partial differential equations (PDE) and was introduced by Osher and Rudin in 1990. Shock filters create strong discontinuities at magnetic edges, and within a region of similar magnetic signature the filtered signal becomes flat. Therefore, shock filtering is able to map fault blocks within crystalline basement in a manner similar to the terracing technique developed by Cordell and McCafferty at the USGS in 1989, which transforms smoothly varying magnetic anomalies into domains of uniform properties separated by sharp boundaries that look more like a geological map.

This shock filter was applied to the reduced-to-pole regional total aeromagnetic intensity grid covering the Peace River Arch of the Western Canada Sedimentary Basin. The total intensity grid was derived from the public domain aeromagnetic database provided by the Geological Survey of Canada. The results obtained from applying shock filters on the aeromagnetic image are very interesting: in addition to mapping structural discontinuities that might be associated with basement faults, the shock filter was able to segment magnetic anomalies into zones of uniform properties with different magnetic signatures. These segments are most likely related to different fault blocks or geological domains in the basement. This abstract discusses how basement blocks and block faults in the Precambrian basement of the Peace River Arch were mapped using shock filters.