Multi-Physics Data Acquisition, Processing, and Interpretation

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What kinds of Geophysical Data should be used?

Various kinds of geophysical data are available, often indicated as Multi-Physics data. Usually, they are separated into Seismic and Non-Seismic. Seismic is, without any doubt, the main method used in the industry. But Non-Seismic data (gravity, magnetics, electrical, electromagnetics, etc) is the main source of information in shallow subsurface applications (engineering, mapping pollution, archaeology). It is also used in the early reconnaissance of new basins and plays and in mapping prospects below salt/basalt (Magneto-Telluric). However, seismic has its limitations and therefore also other geophysical methods are used successfully as complementary data in subsurface evaluation. In combination with seismic data, they can significantly reduce the uncertainty of subsurface models as they measure different physical properties of the subsurface. Another important application is in determining the depth to basement.

The course.

First, various aspects of gravity will be discussed, such as the Earth gravity field, determining anomalies in the global field, establishing the depth of density anomalies, be it spherical or anticlinal and the resolution, which is limited related to being a potential field. Most promising is the development of gravity gradiometer, whereby gradients in the gravity field can be directly measured with great accuracy. These measurements are less sensitive to airplane and ship movement.

Then, the Earth's magnetic field will be studied. Being mainly due to the internal dipole source, the inherently more difficult interpretation is simplified by applying a transformation to a monopole field (Reduction to the Pole or Equator). As different causative sources can produce the same surface measurements, non-uniqueness is also an issue. However, promising developments to mitigate these issues will be shown.

The third part deals with electrical and electromagnetic data. Especially Controlled Source EM (CSEM) data, measuring resistivity, is widely used as a direct indicator of hydrocarbons. Finally, we will discuss the "latest and greatest" that is Machine Learning, a part of Artificial Intelligence, which is step-changing the geoscience world. We will discuss its applications and use open-source software Weka and TensorFlow for exercises. After the course, you should be able to try out Machine Learning on your own data. At the end a quiz will be done.

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