

Maximizing returns on data acquisition investment through multi-physics geophysical and geological integration in the exploration for mineral resources

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The mining industry is facing challenging times: the number of world-class (i.e. tier 1) mineral discoveries is declining, expenditures are decreasing and exploration for resources is becoming increasingly complex, as it is moving to areas under deeper cover, in more complex geologies and at greater depth. To tackle these issues, authors (e.g. Mc Cuaig, 2017) have suggested to apply the same exploration workflows currently employed by the petroleum industry. Indeed, over the recent years the oil and gas industry has been facing the same challenges.

The integration of multiple geophysical measurements, seismic and non-seismic (Tartaras et al., 2011), as well as of complementary geosciences (i.e. geophysics and geology), is an approach that can reduce exploration uncertainty in a budget-friendly fashion. Its success lies in the possibility to leverage existing datasets, which are conventionally acquired and analyzed separately, as well as in the fact that the proposed geophysical disciplines are generally less expensive than other exploration techniques. Different workflows can be applied at different scales, starting from the basin/arc, moving through the camp down to the prospect scale. Integration can occur by means of data fusion, co-rendering, cooperative geophysical inversion, numerical simultaneous joint inversion (SJI; see De Stefano et al., 2011; Mantovani, 2016) or construction of a shared earth model.

The objective of this presentation is to foster the discussion around the topics of multi-physics integration of multiple geophysical datasets and of simultaneous joint inversion. I will show examples ranging from a basin-scale study with gravity and satellite imagery in Western Turkey, through magnetotelluric exploration in a gold mine in Eastern Europe, to quantitative integration via SJI of 2D seismic and airborne gravity gradiometry data in Africa. All these and other examples will demonstrate that integration, performed either in a cooperative or joint fashion, using either qualitative or quantitative techniques, is effective in reducing exploration risks providing an excellent return on the original acquisition investments.