# Mapping Structure of Hydrocarbon Reservoirs Using Geochemical Vectoring

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Geochemical vectoring was initially developed in 1987 by MagmaChem as an exploration tool for the mineral industry. Its application to metal exploration significantly decreased risk resulting in the discovery of 21 economic gold, copper, and silver deposits on 3 continents. These deposits have a total metal value of more than $65 billion and provide a strong geologic and economic proof-of-concept for geochemical vectoring. Initial application of geochemical vectoring to oil and gas exploration, beginning in 2002, suggests that a similar risk reduction and return on investment could be realized.

Geochemical vectoring is based on fractional differentiationthe idea that as a fluid plume moves from its source through the earth's crust to a depositional site, its composition and mineralogy changes in a systematic way due to decreasing temperature and pressure, and increasing oxidation state. The resulting "chemical trail" and element dispersion plumes can be mapped which identify structural plumbing and then used to risk mineral, oil and gas, and geothermal prospects. Geochemical vectoring of hydrocarbon accumulations identifies patterns in trace-element geochemistry of soils and in drill core and cuttings above and lateral to hydrocarbon accumulations reflecting both the hydrocarbon and the brine component of the fluid. Through cluster analysis, element assemblages are determined. These are plotted on maps along with single-element contours and integrated with geology and geophysics. From these maps, vectors are determined between and within assemblages, structural plumbing is identified, kinematic structural analysis is applied, a fluid migration/deposition model is constructed, and drill targets are identified.

During its initial application to oil and gas exploration, geochemical vectoring identified both hydrocarbon accumulations and uneconomic "dry" prospects. It has been successfully applied to five on-shore oil and gas fields and three on-shore oil and gas exploration plays and was also instrumental in the development of an economic geothermal system. All predictions made by the geochemical vectoring technique were correct, i.e., a positive signal for hydrocarbons was identified for the wells encountering oil or gas, whereas no hydrocarbon signal was observed for the dry prospects. One oil prospect has yet to be drilled, save for two pre-geochemical vectoring holes, both of which had shows on the flanks of the prospect's geochemical anomalies. Drill targeting based solely on the geochemistry would have discovered the oil and gas fields in the case histories, but is ideally used in conjunction with other exploration tools to maximize risk reduction.