

Seepage-Induced Magnetic Anomalies Associated with Oil and Gas Fields: Onshore and Offshore Examples

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The presence of magnetic anomalies over oil and gas fields has been noted for several decades, but it is only in recent years that the phenomenon has been critically examined. Studies of geologically and geographically diverse regions document that (1) authigenic magnetic minerals occur in near-surface sediments over many petroleum accumulations, (2) this hydrocarbon-induced mineralization is detectable in high resolution, broad bandwidth magnetic data acquired at low altitude and with closely-spaced flight lines, and in ground magnetic surveys, (3) the magnetic susceptibility analysis of drill cuttings and near-surface sediments confirms the existence of the aeromagnetic anomalies, (4) sediments with anomalous magnetic susceptibility frequently contain ferromagnetic minerals such as greigite, maghemite, magnetite, and pyrrhotite, and (5) approximately 80% of oil and gas discoveries are associated with hydrocarbon-induced magnetic anomalies.

The association between hydrocarbon seepage and the formation of authigenic magnetic minerals in the near-surface has important applications in hydrocarbon exploration. Application of this methodology can quickly identify the areas or prospects with the greatest petroleum potential. Although the discovery of shallow sedimentary magnetic anomalies does not guarantee the discovery of hydrocarbon accumulations, it does identify areas requiring more detailed evaluation, thereby focusing attention and resources on a relatively small number of high potential sites. Proper integration of near-surface magnetic data with geologic and seismic data can improve exploration success and reduce development costs. This presentation will be illustrated with examples from North Africa and North America, including the deep-water Gulf of Mexico.