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Metal anomalies in Geogas above oil reservoir and its significance for oil exploration

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Geogas survey used to be as a tool for mineral exploration of metals deposits in China (Wang, et al., 2008; Gao, et al., 2011). Little attention was paid to use it for oil and gas exploration. To understand the geogas features above the oil reservoir the Hongte basin, one of the oil bearing Erlian subbasins was chosen as pilot study area.

The Erlian basin, an important oil bearing basin in China, is located in the inner Mongolia, northern China. Erlian Basin is an Early Cretaceous rift basin group and comprises more than 40 small fault basins with individual area ranging from 150 to 4200 km^2 (Dou et al., 1998). To date, potential oil resources are estimated at 1, 170 million tons (8, 564 million barrels), in which 234 million tons (1, 713 million barrels) are proved in fifteen oil fields. The Hongte subbasin is located in the southeast of Erlian basin.

200 geogas samples were collected in liquid collectors above the known oil reservoir in the Hongte subbasin in 2011. More than 40 elements including Cu,Pb,Zn,Ag, Ni,Co,Mo,Bi, Sb and REE were determined by HR-ICP-MS. In contrast with common gas indicators for oil and gas exploration soil samples corresponding to geogas sample sites were collected and analyzed for hydrocarbons including methane, ethane, propane, butane and pentane.

The results show a number of metals including Cu,Pb,Zn,Ag,Cd in geogas markedly increase around the known oil pool and formed strong circular or semi-circular anomalies. The response ratios dividing each sample value by the background value of each section for each element were calculated to reduced diurnal change and the ratios for some elements including Cu, Pb, Bi can reach 100. the indicators of hydrocarbons including methane, ethane, propane, butane and pentane increase directly above the known oil pool and form apical geochemical anomalies.

A bore hole up to 600m was drilled to verify the geological meaning of geogas anomalies right on the peak of geogas anomalies. 80m loosely bonded fine grain pyrite was intersected at the depth of 250m although most of drill core consists of cretaceous loosen or half- consolidated sand. The authors think the formation of pyrite layer was related to the known oil pool and the metals from oil pool area can make their way to surface through the above cover sand. The mechanism of sulfide formation around the oil reservoir can be explained by the theory of the electrochemical transport related vertical redox anomalies or vertical “reduced chimney ”. Discovery of geogas anomalies and sulphide layer around the oil pool can explain a geophysical phenomenon, induced polarization anomalies surrounding the oil reservoir. It is thus concluded that the geogas geochemistry can be used as a exploration tool for oil and gas but more study should be done on the relationship between geogas anomaly and oil & gas pool.

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