Application of geo-microbial prospecting method for evaluation of hydrocarbon micro-seepage pattern in oil and gas fields of Mehasana, Cambay Basin, Gujarat, India

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Geo-microbial method for hydrocarbon exploration is the search for surface microseeps as clue to the presence of an active petroleum system and / or to the location of possible oil and gas accumulation. The paper presents the results of microbial prospecting survey carried out in existing Oil and Gas fields of Mehasana, Cambay basin, Gujarat, to define the geo-microbial signatures, to evaluate the hydrocarbon micro seepage pattern and to investigate whether the geo-microbial anomalies that can establish an upward migration of hydrocarbons from the deep subsurface over oil and gas proven areas. A set of 135 sub-soil samples collected, were analyzed for indicator hydrocarbon oxidizing bacteria. The microbial prospecting studies showed the presence of high bacterial population for methane (5.4 x 10^6 cfu/gm), ethane (5.5 x 10^6 cfu/ gm), propane oxidizing bacteria (4.6 x 10^6 cfu/gm) and butane oxidizing bacteria (4.6 x 10^6 cfu/gm) in soil samples. The high bacterial populations of hydrocarbon oxidizers were found between the producing wells and these high microbial concentrations were found to be either surrounded by radial withdrawal patterns. Mehasana is one of the larger Oil and Gas fields in India, and all of the predicted microbial patterns have been identified. Clusters of low microbial populations found over or adjacent to many of the producing wells, identify the reservoir drainage radius around the wells. Areas of high microbial activity of hydrocarbon oxidizers were found between the producing wells which indicate pockets of unproduced hydrocarbons within the field.

Integrating the microbial data with geologic and geophysical information can identify the drainage fabric within the reservoir to help define the most appropriate well spacing and well pattern and identify bypassed reserves for particular reservoirs. The study confirmed that seepage of light hydrocarbon from microbial studies and help in evaluation of hydrocarbon micro seepage pattern.

Climatic controls of regolith weathering and mass flux in granitic terrain – A synthesis of Critical Zone Exploration Network data

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What controls the depth and chemistry of the Earth's regolith? Answering this question is key to understanding landscape evolution, soil forming processes, and the feedback between mineral weathering and atmospheric carbon dioxide levels. We present a synthesis of regolith weathering data for granitic terrain associated with the Critical Zone Exploration Network. Data for regolith and rock geochemistry, climate and landscape age were compiled and a regolith geochemical mass balance calculated relative to bedrock using an immobile element approach [1]. A unitless mass transfer coefficient (τ, g g^{-1}) and mass flux (δ, g m^{-3}) were calculated for the entire regolith profile at each site [2]. The τ depletion profiles indicated greater depth of weathering and near complete loss of cations such as Na with increasing precipitation. Regolith integrated τ and δ values demonstrated threshold type functions relative to mean annual precipitation, with a dramatic increase of Si and cation loss above a mean annual precipitation (MAP) of 1,000 mm yr^{-1}. We fit a range of functions to depth profiles of bedrock normalized Na concentrations (mol m^{-3} regolith) to derive a lumped kinetic parameter (K), assuming albite weathering dominated the observed Na mass loss [3]. The regolith K values followed an exponential decay function relative to MAP, with the greatest K values at low precipitation, *i.e.*, less than 500 mm yr^{-1}, that decreased asymptotically with increasing MAP. The data suggest an interaction of climate, weathering rate and mass flux in that low MAP sites exhibited minimal mass loss but potentially rapid kinetics. This pattern reversed in a threshold-like fashion to large regolith mass flux and slow weathering kinetics with increasing precipitation.

[1] Brimhall *et al*. (1992) *Science* **255**, 695-702. [2] Anderson *et al*. (2002) *GSA Bulletin* **114**, 1143-1158. [3] Brantley *et al*. (2008) *Geoderam* **145**, 494-504.