

The Surface Geochemical Expression of the Jonah Gas Field, Sublette County, Wyoming

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A regional soil and sagebrush geochemical survey was carried out over the Jonah tight gas sand field in Sublette County, Wyoming to determine which, if any geochemical methods, could detect the field. More specifically, the geochemical methods were tested to see if:

- (1) There is an anomalous response in major and trace elements in sagebrush leaves over the field.
- (2) There is an anomalous response in hydrocarbons and/or major and trace elements in soils over the field.

Big Sagebrush leaves (*Artemisia tridentata*) and soil samples were collected at 0.7-mile intervals on a 10-township rectangular grid. Sagebrush leaves (n=871) were dried, macerated, digested in aqua regia acid, and analyzed for 53 major and trace elements by Inductively Coupled Plasma Mass Spectrometry (ICP-MS). Soil samples (n=510) were dried at low temperature, sieved to <63 mm, weighed into air-tight glass vials, heated at constant temperature for constant time, and an aliquot of headspace gas was injected into a Flame Ionization Detector Gas Chromatograph for analysis of C1-C6 alkane and alkene hydrocarbons. Splits of the dried and sieved soil samples (n=325) were also digested in aqua regia acid and analyzed for 26 major and trace elements by Inductively Coupled Plasma Emission Spectrometry (ICP-ES).

The main conclusions from the evaluation of surface geochemical methods over and around the Jonah field are:

- (1) Soil gas over the over-pressured Jonah field is anomalous in “wet gas” components (i.e. C4 to C6 alkanes) relative to normal-pressured areas outside the field. The over-pressure at Jonah presumably promotes the ascent of wet gases to surface as opposed to normal-pressured areas outside the field. Wet gas anomalies (e.g. percent pentane) are aligned with the southern and western wrench faults that bound the Jonah field and the southeast-plunging Pinedale Anticline.
- (2) Nickel, cadmium and barium are anomalous in sagebrush leaves over the South Pass Shear Zone (wrench fault) to the south of Jonah, the southeast-trending Pinedale Anticline, and some northwest-trending thrust faults. These heavy metals were probably leached from underlying black shales by fluids that eventually migrated to surface along permeable structures for uptake and incorporation in Big Sagebrush tissue.

In summary, wet C4 to C6 soil gases effectively outline the surface expression of the over-pressured Jonah tight gas sand field. This regional soil gas method could be useful in exploration programs for other over-pressured tight gas sand fields in the Green River Basin and elsewhere. The trace element signatures in Big Sagebrush leaves reflect heavy metal uptake over structures leaking fluids to surface. The regional sagebrush geochemical method could be effective for finding other major anticlines and faults in the Green River Basin and elsewhere.