New Techniques for New Discoveries—Results from the Lisbon Field Area, Paradox Basin, Utah, David M. Seneshen, Vista Geoscience, 130 Capital Dr., Suite C, Golden, CO 80401; Thomas C. Chidsey Jr., Craig D. Morgan, and Michael D. Vanden Berg, Utah Geological Survey, P.O. Box 146100, Salt Lake City, UT 84114

Exploration for Mississippian Leadville Limestone-hosted hydrocarbon reservoirs in the Paradox Basin is high risk in terms of cost and low documented success rates (~10 percent based on drilling history). Only 100 wells have penetrated the Leadville over an area of the 7,500 mile^2, which equates to about one well per township. The potential for more hydrocarbon reserves is thus enormous, but the high cost of 3-D seismic exploration methods in environmentally sensitive areas deters small independents from exploring for Leadville hydrocarbon reservoirs.

This study was therefore initiated to evaluate the effectiveness of low-cost, innovative, non-invasive, surface geochemical methods for predicting the presence of underlying Leadville hydrocarbon reservoirs. Lisbon was chosen for testing because it is the largest Leadville oil and gas producer in the Paradox Basin, and a nearby recently discovered Leadville field (Lightning Draw Southeast) is also available for comparison. Surface soils (n=400), outcrop fracture-filled soils (n=33) and lichen (n=29), and 6-foot-deep free gas samples (n=40) were collected at intervals ranging from 50 to 500 meters over productive and barren parts of the Lisbon and Lightning Draw Fields. The soil and lichen samples were analyzed for thermally desorbed hydrocarbons in the C_1–C_{12} range, heavy aromatic hydrocarbons (C_6–C_{40}), organic carbon, 53 major and trace elements, and seven anions. Free gas samples were analyzed for hydrocarbons (C_1–C_8), hydrogen, helium, carbon dioxide, carbon monoxide, oxygen, and nitrogen. The data were interpreted using multivariate statistical methods. The main conclusions of the study are:

(1) The microseepage over the gas cap, oil leg, and water-leg at Lisbon is distinguished based on hydrocarbon, fluorescence, and metal associations in surface soil and outcrop fracture-fill soil and lichen samples. Important variables for distinguishing productive and barren areas are light alkanes and aromatics (C_1–C_6), uranium, vanadium, cadmium, molybdenum, and lead. Heavy aromatic hydrocarbon anomalies observed over productive areas could represent biodegraded Lisbon condensate and oil seeps.

(2) Productive “Lisbon-type” microseepage signatures are observed over the recently discovered Leadville Lightning Draw Southeast gas condensate field southwest of Lisbon. Compositional signatures over the Lightning Draw Field also predict productive parts of Lisbon.

(3) Light alkane (C_1–C_6) and hydrogen anomalies in 6-foot-deep free gas are spatially associated with production at the Lightning Draw Field.

(4) Recommendations for future geochemical surveys in the Paradox Basin are:

(a) Reconnaissance exploration should include the collection of surface soils (outcrop fracture-fill media where applicable) for hydrocarbon and major/trace element analyses.
(b) Anomalous areas identified in reconnaissance soil surveys should be followed up with the extraction and hydrocarbon analysis of deep free gas samples collected at short intervals (<100 meters).