Wednesday, November 11, 2015

Black Lab Pub, Churchill Room • 4100 Montrose Blvd.
Social 5:30 p.m., Dinner 6:30 p.m.

Cost: $30 Preregistered members; $35 non-members/walk-ups

**To guarantee a seat, pre-register on the HGS website & pre-pay by credit card.
Pre-registration without payment will not be accepted.
Walk-ups may pay at the door if extra seats are available.**

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Consultant

Lead-Zinc Mineralization as an Indicator of Downdip Unconventional Resources

While the geophysical evaluation of unconventional resources (organic-rich black mudstones/shales) has made great strides, understanding the geological aspects, particularly in respect to the greater depositional basin, has lagged. Exploration has been largely a matter of drilling wells and analyzing what turns up. There is a need for more efficient exploration.

In addition to organic material, which can mature into hydrocarbons with burial, organic-rich black shales are often enriched in metals, including Ag, Au, Ba, Cd, Cr, Cu, Hg, Mo, Ni, Pb, Re, Se, U, V, Zn and platinum group minerals, sometimes to the point of becoming ores. In the past, because the exploitation of conventional migrated hydrocarbons and mining ores were so different, the relationship was largely ignored. This was in spite of frequent traces of metals in hydrocarbons and the occurrence of hydrocarbons in mine workings. Beyond that, what we may learn about how the metals are concentrated, mobilized and move may permit better recognition of environmental hazards and economic opportunities.

Mississippi Valley type (MVT) base metal sulfide deposits are characterized by lead and zinc minerals, accompanied by pyrite and often copper and barium minerals and fluorite. They are also marked by the "ubiquitous" presence of hydrocarbons, often heavy oil or bitumen. They usually occur in carbonates; much of the mineralization appears to be void-filling (often associated with unconformities and/or karst). Dissolution and brecciation of host carbonates, precipitation of dolomite and calcite cements, and recrystallization of pre-existing dolomite are also characteristic. The ore deposits are commonly localized by faults or fractures.

Models of ore metallization have centered on metal-bearing fluids associated with igneous activity and/or derived from the basement. These produced vein-type deposits, pegmatites, or disseminated deposits in large intrusions. When ore minerals occurred in sedimentary deposits, they were still considered to have originated in unknown crystalline rocks, with hydrothermal fluids precipitating the minerals in favorable locations.

However, the occurrence of low-temperature lead-zinc mineralization over a very large area, co-extensive with metal-rich black shales, suggests that the shales themselves may be the source of the metals, which have been mobilized and reprecipitated in adjacent rocks. This phenomenon is widespread; locally the escaping fluids may be focused into MVT ore deposits. Mobilization and movement of these metals is analogous to, and possibly closely linked to, maturation and migration of hydrocarbons. In the case of the Midcontinent Pennsylvanian, there are no regional aquifers capable of long-distance transport or retaining elevated temperatures of basin-derived fluids; the sheer volume of zinc in the observed occurrences also becomes an issue. If this is a valid model, the occurrence of deposits is an indicator that somewhere downdip is a metal-rich, organic-rich black shale, possibly mature enough to generate recoverable hydrocarbons.

The nature and quantity of the metals in the shales may be a function of the organic matter type present, since different types have different affinities for specific metals. When and how those metals move provide evidence of the thermal and geochemical state of the source rocks.

If the metal ions in ground water systems are from metal-rich organic-rich shales, rather than unidentified igneous activity, then it should be possible to model the range of conditions where these metal ions are released. With knowledge of the fluid flow in a basin, it should be possible to generate at least a qualitative model of where metals in solution might be expected; sort of a BasinMod for ions in solution. Where the ions are present, their sources, and their possible precipitation points should all be part of the model. ■

Biographical Sketch

Steve Schutter received graduate degrees in geology from the University of Iowa, where he studied the depositional environments of Ordovician and Pennsylvanian shales. He went on to Exxon Production Research, where he worked on Paleozoic eustasy and the stratigraphic expression of salt tectonics, as well as on several regional studies. This was followed by work for Subsurface Consultants and at Murphy International E&P. In addition to writing on Paleozoic eustasy and the depositional environments of shales, he has also published on hydrocarbons associated with igneous rocks. He is currently working with geological models for unconventional resources, including a classification system for organic-rich shales and methods to recognize the stratigraphic parameters of sweet spots.