Integrated Hydrothermal Dolomite (HTD) Gas Conceptual Exploration Model and the Identification of an Unrecognized Major Mg-Hydrocarbon Source

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Studies of HTD Trenton-Black River gas fields of the Appalachian Basin produced an integrative HTD gas model that may explain the generation, transport, and deposition of anomalous amounts of Mg and hydrocarbon that characterize HTD and Mississippi Valley Type zinc deposits (MVT) deposits. These deposit types may identify previously unrecognized major hydrocarbon basement sources. The new model agrees with experimental data and mass-balance calculations that add new constraints to the previously enigmatic HTD gas problem, as well as basin-centered gas. The reaction sequence below utilizes constraints derived from fluid fractionation modeling, transcurrent shear-zone kinematics, geochemistry, and basement structural data. The reaction sequence (in reduced crust) is: Stage 1--generation of methane-hydrocarbon stable metagenic fluids from serpentinization of peridotite in intracratonic failed rifts or collisional sutures in the basement when triggered by compressive, convergent orogenesis and subsequent ascension through probable transpressive conduit systems; Stage 2--initial, low temperature 'passive' dolomitization of the first replaceable shelf carbonate in the overlying cratonic cover sequence; Stage 3A--early saddle dolomitization at or near depositional site; Stage 3B--late saddle dolomitization, anhydrite formation, carbon dioxide effervescence, hydrogen loss and methane unmixing; Stage 4--sulfide and hydrocarbon deposition; and Stage 5--deposition of late calcite at depositional site and illite/smectite/kaolinite clays in and marginal to depositional site. Gas-charged fluids may continue to ascend to higher levels, where they deposit gas charge in higher level sandstone reservoirs. The new hydrothermal hydrocarbon model views basin petroleum resources from the 'bottom- up', especially where that bottom is basement peridotite.

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