Regional Thermobaric Dolostone (RTD): A Distinct and Economically Important Petroleum Lithosystem

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Recent major gas discoveries at Ladyfern, British Columbia, Fort Liard, Northwest Territories and Gloades Corners, New York, have rekindled industry interest in hydrothermal dolostone (HTD) plays. Despite these spectacular drilling successes, HTD plays remain poorly understood because they typically do not fit within traditional stratigraphic or structural models. Consequently, we need to develop alternative concepts to explore for and exploit HTD reservoirs. This paper proposes that hydrothermal dolostones often form part of a previously unrecognized, distinct, and economically important petroleum lithosystem, possessing a unique set of reservoir attributes. The term “RTD – Regional Thermobaric Dolostone” is introduced to refer to this system. The six key attributes of RTD lithosystems are: 1) Thermobaric (hydrothermal) dolostones and related lithofacies form the principal reservoir facies within otherwise tight and generally non-prospective carbonate platforms. The term “thermobaric”, as suggested by Graham Davies, is intended to reflect the hyperthermal, hyperbaric, and possibly hypersaline, multiphase conditions under which RTD diagenesis is believed to occur. 2) Although RTD lithologies and associated minerals are highly variable, they constitute a recognizable assemblage. Prospective reservoirs occur within dolostones, leached host rock (typically limestone), or mineralized facies including sulfide, silicate, sulfate and fluoride fabrics. 3) RTD rock bodies exhibit unusual geometries which crosscut strata and major formational boundaries within the host carbonates. “Plume and collapse” features are common. 4) Degraded organics and carbon dioxide gas are usually associated with RTD rocks. Textural evidence suggests that hydrocarbons (liquid and/or gaseous) were often present at the time of reservoir diagenesis. 5) RTD lithosystems demonstrate regional-scale hydraulic continuity and normal or close-to-normal pressurization. 6) Seismic, aeromagnetic, gravity and other mapping evidence reveal frequent extensional or trans-tensional structures in RTD settings, including suborthogonal fault and fracture patterns, rhombochasm features, en-echelon or lateral offsets, and rift/graben features. The diagenetic mechanisms which lead to the formation of RTD lithofacies remain controversial. This author favors a process in which thermobaric, redox-coupled and redox-catalysed reactions are triggered by a regional extensional event and sustained by advective heat and mass transport. These mechanisms provide a compelling explanation to account for the diverse suite of mineral and gas phases, rock textures, geometries, and regional hydraulic networks associated with the RTD lithosystem.