Lithofacies, detrital petrology, and diagenesis of the mid-Cretaceous Chaswood Formation, Elmsvale Basin, Nova Scotia

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The mid-Cretaceous Chaswood Formation of central Nova Scotia is a fluvial sand-clay succession that is the proximal equivalent of offshore deltaic reservoir rocks of the Scotian Basin. Borehole RR-97-23 provides a section, 130 m long, that penetrates all three members of the Chaswood Formation and has thus been studied in detail using a variety of analytical techniques. The rocks have been classified into 22 lithofacies and five main facies associations: light grey clays, dark grey clays, silty clays and muddy sands, sorted sands and gravels, and paleosols. Facies associations were based on the frequency of transitions between facies, as determined by the construction of a lithofacies transition matrix. Facies transitions in the coarser facies are related to deposition in and near fluvial channels; in the mudrocks, the transitions indicate a progression from the dark grey clay association (swamps and floodplain soils) to mottled paleosols (well drained soils following syntectonic uplift). The light grey clay association formed from early diagenetic oxidation and alteration of the dark grey clay association.

The bulk mineralogy of 176 sandstone and mudrock samples was determined by X-ray diffraction. Principal minerals in the mudrocks are illite/muscovite, kaolinite, vermiculite, and quartz, with rutile, hematite, and goethite in the paleosol association and siderite and pyrite in the dark grey clay association. Both mudrock and sandstone were examined using a scanning electron microscope to aid in the identification of diagenetic mineral growth. Sandstone samples were examined further using an electron microprobe to characterize both the detrital and diagenetic petrology. Translucent heavy minerals in the sandstone comprise stable and unstable assemblages, indicating the potential for both proximal immature sources and more distal and/or polycyclic sources. Ilmenite is the most common opaque heavy mineral and is variably altered to rutile; detrital rutile, magnetite, and titano-magnetite are also present. In the sandstone, only the interior of muscovite grains is altered to kaolinite, indicating weathering in the source area. The earliest phase of sandstone cementation, occurring under reducing conditions in swamps and ponds, produced siderite nodules and framboidal pyrite, which were later corroded and oxidized during development of paleosols. Kaolinite is an early cement, occurring as a coating on quartz grains and as well-crystallized, pore-filling booklets. Later illite and barite cement indicate a source of abundant K and Ba in formation waters.

The sediment delivered to the Chaswood Formation is equivalent to that deposited in the Logan Canyon Formation delta offshore, where sandstone layers are reservoirs for important gas fields. Although part of the same sedimentary system, the offshore deposits experienced marine rather than subaerial early diagenetic processes and more advanced diagenesis associated with greater depth of burial. Analysis of the Chaswood Formation does, however, provide information on the early stages of diagenesis and may therefore be used for comparative purposes in order to better understand the processes that lead to the development of good reservoir rocks.