Stratigraphic Framework of Cretaceous Diamond-bearing Kimberlites, East-central Saskatchewan

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Abstract

Numerous diamond-bearing kimberlites have been discovered in the Fort à la Corne region in east-central Saskatchewan in recent years. Unlike most other kimberlites worldwide, the central Saskatchewan occurrences consist primarily of pyroclastic deposits, which are interstratified with Lower Cretaceous (Albian) marine, marginal marine, and continental sediments.

The Phanerozoic sedimentary sequence is quite thin in east-central Saskatchewan. Basement rocks are overlain by ~400 m of Paleozoic (primarily Devonian) strata which are in turn overlain by ~120 to 250 m of Cretaceous clastic sedimentary rocks and ~90 to 125 m of Pleistocene glacial till. Cretaceous strata consist of the predominantly continental to marginal marine Mannville Group (Cantuar and Pense formations) and the predominantly marine Lower Colorado Group (Joli Fou, Westgate, and Belle Fourche formations) (Figure 1). Radiometric age determination and micropaleontological evidence support the hypothesis that multiple kimberlite eruptive phases occurred. The earliest of these may have occurred as early as the late Aptian, with successive eruptive events throughout the Albian, possibly continuing into the Lower Cenomanian.

The oldest kimberlites are contained within the lower to middle Cantuar Formation, with most kimberlites being found in the upper Cantuar Formation. The Cantuar Formation was deposited in a variety of depositional settings including: continental fluvial (fluvial channel and alluvial floodplain), shallow lacustrine, deltaic, and/or estuarine. Kimberlites within the Cantuar Formation include terrestrial airfall deposits as well as fluvially transported kimberlitic sandstone and conglomerate.

Kimberlites also occur within the Pense Formation, which were deposited in shoreface, deltaic, and marginal marine environments. Kimberlites within the Pense Formation consist primarily of terrestrial airfall deposits and marine reworked equivalents, while fine- to medium-grained cross-stratified kimberlitic (olivine-dominated) sandstones are also common.

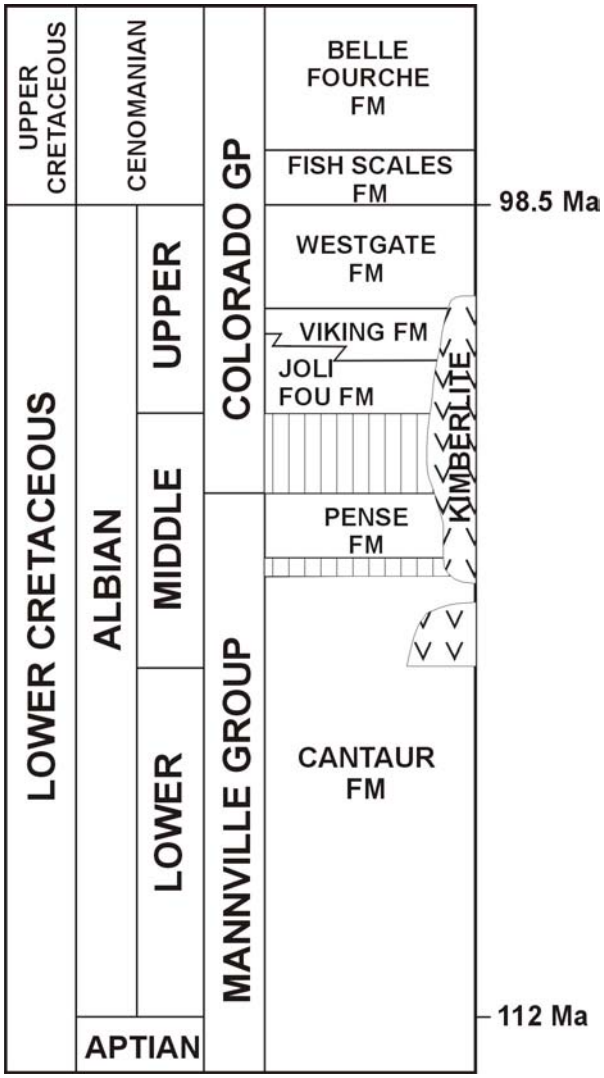

Figure 1 - Cretaceous stratigraphic position of central Saskatchewan kimberlite. Vertical hatched pattern represents no time-rock record (modified from Kjarsgaard, 1995).

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The Mannville–Lower Colorado contact reflects a regional marine transgression. Subjacent strata, including terrestrial airfall kimberlites and positive-relief tephra cones were beveled off (reworked) by this transgression. Lower Colorado strata include three main shale intervals (Joli Fou, Westgate, and Belle Fourche formations). These black shale units contain several sandstone-rich intervals including, from base to top, the Spinney Hill Formation, the Flotten Lake Sandstone (Viking equivalent), the Newcastle Sandstone, and the St. Walburg Sandstone. Primarily, these units reflect deposition in distal to proximal offshore and offshore/onshore transition settings; locally they shallow into shoreface sandstone bodies. Kimberlite beds, at several horizons within these units, consist predominantly of marine airfall deposits. In some areas, these kimberlites exhibit evidence of wave reworking, indicating areas of shallow water in the Lower Colorado seaway of central Saskatchewan.

Reference

Kjarsgaard, B.A. (1995) Research on kimberlites and applications of diamond exploration techniques in Saskatchewan; *in* Richardson, D.G. (ed.), Investigations completed by the Saskatchewan Geological Survey and the Geological Survey of Canada under the geoscience program of the Canada-Saskatchewan partnership agreement on mineral development (1990-1995), GSC Open File 3119, Sask. Energy Mines Open File Rep. 95-3, p213-226.