Detrital zircons as provenance indicators in the Cretaceous Chaswood Formation

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The morphology and internal structure of detrital zircon in sandstones can be used to recognize different source rocks. Such characterization is an important preliminary to expensive dating of detrital zircon. Different types of igneous and high grade metamorphic rocks show different types of zoning and inclusions and zircons reworked from older sedimentary rocks are generally highly abraded.

Current models for the provenance of the fluvial Chaswood Formation of New Brunswick and Nova Scotia are based on gravel clast petrology, bulk heavy mineral assemblages, and detrital monazite geochronology. These studies suggest that at least three discrete rivers supplied coarse-grained sediment to southern New Brunswick, central Nova Scotia, and eastern Nova Scotia respectively. The purpose of the present study is to test these models of provenance and sediment dispersion using detrital zircon.

Polished thin sections of heavy mineral separates were prepared from loosely consolidated sandstones from the Vinegar Hill pit in southern New Brunswick, borehole RR-97-23 from the Musquodoboit Valley, boreholes from Brierly Brook near Antigonish, and from Diogenes Brook in western Cape Breton Island. Backscattered electron (BSE) and cathodoluminescent (CL) images were obtained from almost 800 grains by scanning electron microscope. The grains were classified on the basis of external morphology, type of zoning, and the type, size, and abundance of inclusions.

Grains from Vinegar Hill are dominated by euhedral first-cycle igneous zircons that lack prominent zoning and inclusions. The uppermost stratigraphic unit at RR-97-23 is dominated by first-cycle igneous zircons with prominent concentric zoning, whereas the base of the Chaswood Formation at RR-97-23 has a wider range of igneous zircon types and a higher proportion of abraded second cycle zircons. A similar stratigraphic contrast is present at Brierly Brook. Detrital carbonate from the Windsor Group is a significant component of the deeper section at Brierly Brook, consistent with the abundance of abraded zircons perhaps derived from Carboniferous sandstones. The Diogenes Brook sandstones have a wide range of types of igneous zircons, including some that resemble those at Vinegar Hill and some similar to those in the uppermost unit at RR-97-23 and at Brierly Brook.

This study has demonstrated the value of detrital zircon as an indicator of provenance in the Chaswood Formation, but also shows that further work is needed to compare observed zircons with those in potential source rocks. It confirms previous interpretation of three principal rivers, although there is evidence that in upper Chaswood times, Brierly Brook and RR-97-23 might have been supplied by the same river system. It also shows that the older parts of the Chaswood Formation had a higher proportion of second-cycle zircon, presumably derived from Carboniferous rocks uplifted in horsts, which were progressively eroded to reveal crystalline basement rocks.