Denudation of the Appalachians in the Cretaceous: tracking fluvial dispersion with mineral geochronology and chemistry

GEORGIA PE-PIPER[1] AND DAVID J.W. PIPER[2]
1. Department of Geology, Saint Mary's University, Halifax, Nova Scotia B3H 3C3, Canada <gpiper@smu.ca> ¶ 2. Geological Survey of Canada (Atlantic), Bedford Institute of Oceanography, P.O. Box 1006, Dartmouth, Nova Scotia B2Y 4A2, Canada

In the Early Cretaceous of the passive margin Scotian Basin, more than 45 million years after the onset of sea-floor spreading, sandy deltas prograded tens of kilometres seawards. Sand supply was 3–4 times higher than in the early history of the passive margin. Multiple sedimentary petrology methods show that the dominant source of the sand was from the local Appalachians, supplied by at least three different rivers.

Geochronology of detrital muscovite, monazite, and zircon provides a first-order assessment of the source of detrital sediment. Almost all detrital muscovite grains are Late Paleozoic in age. Mass-balance calculations require a few hundreds of metres of exhumation of the inner continental shelf during the Early Cretaceous. The paucity of older ages results from abrasion during transport from more inboard Appalachian terranes.

Most detrital monazite grains are Devonian, but Lower Paleozoic, latest Neoproterozoic, Mesoproterozoic, and Paleoproterozoic grains each make up about 10% of the total assemblage. Although monazite survives mechanical abrasion, it is readily broken down chemically under acid conditions. There is no systematic variation of monazite morphology with age, except that euhedral grains are over-represented in middle Paleozoic ages, characteristic of the outboard Appalachians, and involving short transport distances. This variation indicates that most monazite is of first cycle origin.

Most detrital zircon grains are of Precambrian age, with peaks at 1.0 Ga and 1.7 Ga that are characteristic of reworked zircons in inboard Appalachian rocks of Laurentian prove-

nance. A few samples show peaks at 0.6 and 2.0 Ga, characteristic of outboard Appalachian rocks of Gondwanan provenance. All samples have a few 300-550 Ma zircons, representing Appalachian crystalline basement. Comparing abundance of dated monazite and zircon grains in the same sample provides estimates of the importance of polycyclic reworking. Samples with similar distribution of monazite and zircon ages suggest that most zircons are first cycle, and only a few zircons are rounded or broken. Samples with many zircons older than the monazites have many rounded and broken zircon grains. In such samples, bulk chemical analyses show a good correlation of Zr and Cr. These elements are principally in zircon and chromite, derived from quite different rock types, but resistant minerals concentrated by polycyclic reworking. In contrast, Zr correlates with Ti only at low concentrations, above which the abundance of Ti is largely constant as Zr abundance increases. Ti is transported principally in ilmenite, an abundant first-cycle mineral in proximal fluvial sediments, but very susceptible to chemical weathering. Ce, which is principally present in monazite, shows no correlation with Zr but correlates well with Ti, suggesting that mostly first cycle monazite and ilmenite are concentrated together by sedimentary sorting.

