Detrital Zircon Provenance of Lower Cretaceous Conglomerate Beds in Western Canada and the United States

Andrew L. Leier*
Department of Geoscience, University of Calgary, Calgary, AB Canada
aleier@ucalgary.ca

Cassandra L. Frosini
Department of Geoscience, University of Calgary, Calgary, AB Canada
clfrosin@ucalgary.ca

and

George E. Gehrels
Department of Geosciences, University of Arizona, Tucson, AZ USA
ggehrels@geo.arizona.edu

Lower Cretaceous deposits in western North America are characterized by a relatively thin, but widespread, interval of conglomerate beds that overlie a sub-Cretaceous unconformity. Although well documented, the tectonic and basinal significance of these units remains unclear. Provenance investigations have shed light on some aspects of these deposits (Schultheis and Mountjoy, 1978), however standard provenance methods are hindered by the fact that the conglomerate beds are composed largely of chert and quartzite clasts and their derivatives. We employed detrital zircon uranium-lead (U-Pb) geochronology to better understand the provenance of Lower Cretaceous conglomerate units, constrain their depositional ages, and elucidate the large-scale depositional history of the region during Early Cretaceous time. Our interpretations are based on 900 new detrital zircon U-Pb ages from samples of Lower Cretaceous conglomerate units exposed in British Columbia, Alberta, and Montana.

Lower Cretaceous samples from the Cadomin Conglomerate in British Columbia and Alberta contain populations of detrital zircons with ages between 115-170 Ma and large populations with ages of ca. 1800 Ma. We postulate these sediments were derived from the erosion of Mesozoic arc-related rocks and Proterozoic through Lower Paleozoic strata exposed in thrust sheets in the Cordilleran Orogen. Maximum depositional age for these units varies, but is generally ca. 116-120 Ma. The Lower Cretaceous Kootenai Conglomerate from northern Montana contains similar age populations, although the majority of the zircons have ages between 120 and 180 Ma (Fuentes et al., 2009).

Detrital zircon U-Pb ages from the Pryor Conglomerate in south-central Montana and the Cutbank Sandstone in central Montana differ from those in northern Montana, Alberta, and British Columbia. The Lower Cretaceous Pryor Conglomerate contains numerous detrital zircons evenly distributed between 200-700 Ma and a large population of ca. 1000 Ma grains. We interpret these zircons to have been derived from more southwesterly-located sources, including Mesozoic-age eolianites in Wyoming, Utah, and Arizona.

Based on our samples and those from previous work in the southwestern United States (Dickinson and Gehrels, 2008), we are able to delineate two distinct detrital zircon U-Pb age signatures in Lower Cretaceous conglomerates in western North America. One, we term the “northern” signature, contains detrital zircon populations of 115-180 Ma and ca. 1800 Ma, and occurs in proximal areas of the foreland basin in northern Montana, Alberta and British Columbia. The other, we label the “southern” signature, contains detrital zircon populations of

200-700 Ma and 1000 Ma, and occurs throughout most of the western United States and also extends into more northerly latitudes in the distal (eastern) portions of the foreland basin.

These data provide a means for evaluating paleogeographic reconstructions and also make testable predictions for future provenance studies. Specifically, these data predict a southern detrital zircon U-Pb age signature should be present in Lower Cretaceous strata deposited in distal portions of the Western Canadian Foreland Basin. Based on the zircon ages of likely source areas, it may be possible to reconstruct the relative influx of sediment from the Canadian Cordillera, the US Cordillera, and the Canadian Shield to the ancient fluvial systems that deposited the sediments composing the Manville Group and age-equivalent strata.

References

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