Chemostratigraphy and sedimentary provenance analysis for the Jeanne d'Arc and Flemish Pass basins, Grand Banks, Canada

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The Jurassic–Cretaceous succession of the Flemish Pass, Jeanne d'Arc, and other nearby basins is the focus of this study. The Grand Banks area is associated with the opening of the North Atlantic Ocean, with paleogeographic reconstructions placing it close to the conjugate Irish Porcupine and Rockall basins, and to the landmasses of Greenland and Iberia. Possible sedimentary sources are these landmasses, the Avalon terrane and the Flemish Cap. We coupled Raman heavy mineral (HM) analysis and zircon U–Pb geochronology, with the aim of helping in modelling ground-truth sediment provenance and gross depositional environment maps for the Grand Banks.

The HM were concentrated and identified via Raman spectroscopy; zircon ages were determined via laser ablation - inductively-coupled plasma - mass spectrometry analysis performed on more than 150 samples for a total of 18 wells. We performed elemental analysis via ICP-MS and stable isotope ($\delta^{13}C_{carb}$ and $\delta^{18}O_{carb}$) analysis, to build a chemostratigraphic correlation.

From our multidisciplinary dataset, it is possible to recognize provenance changes occurring both stratigraphically and geographically, and our provenance-related data support our chemostratigraphic correlation. For example, in Jurassic and Cretaceous sediments of Harpoon O-85 well (Flemish Pass Basin), Neoproterozoic zircon ages are predominant, followed by Paleoproterozoic and Paleozoic ages. In Terra Nova I-97 (Jeanne d'Arc Basin), Jurassic sediment has Neoproterozoic (most abundant), Paleozoic, Mesoproterozoic, and Paleoproterozoic zircon ages, whereas Cretaceous sediment has Neoproterozoic and Paleozoic grains. From these data, we interpret a different provenance between the Flemish Pass and the Jeanne d'Arc basins and, in the latter, a change at the Jurassic–Cretaceous boundary. Heavy mineral and zircon ages that suggest provenance from the Flemish Cap were observed in the Cretaceous sediments of Harpoon O-85.

On the basis of elemental (variations in Si, Zr, Ti, Nb, Ta, Rb, U, Th, Ga, V and REEs associated with changes in quartz, feldspar, heavy minerals, clays, and organics), isotopic, and zircon geochronological data, Hibernia equivalent sandstones penetrated by the St. George J-55 well (Carson Basin) have been divided into three packages. Two of these three can be correlated with two packages occurring in the Hibernia sandstones penetrated by Terra Nova I-97 (Jeanne d'Arc): the deepest one of J-55 has not been deposited or has been eroded away from the succession penetrated by I-97.

Atlantic Geology, 2018, Volume 54
Conjugate Margins Conference 2018, August 19-22, 2018
doi: 10.4138/atlgeol.2018.014