# Nd-monazite Occurrence in North America: Mesoproterozoic Siliciclastic Rocks of the Belt-Purcell Supergroup

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This study reports the occurrence of Nd-monazite in the Belt-Purcell Supergroup rocks of western North America. Grains of this mineral were found in the Mesoproterozoic medium-coarse grained sandstones of the Grinnell Formation, at Red Rock Canyon in Waterton-Glacier International Peace Park, southwestern Alberta, Canada.

Monazite is a monoclinic orthophosphate of mainly cerium with the chemical formula $(LREE)PO_4$. Most monazites contain Y, Th, U, Ca in their lattice. Average monazite $Ce_2O_3$ content varies between 21 and 32 wt%; $(La, Nd)_2O_3$ from 28 to 35 wt%; $ThO_2$ from 6 to 11 wt%; and $P_2O_5$ content is ~18 wt%. Nd-monazite has been reported from the Marmara bauxite, Greece [1], and from the Formazza Valley, Italy [2].

In this study thirty-four monazite grains were analysed using a Cameca SX-100 electron microprobe. The neodymium content is unusually high in this monazite population, reaching up to 31 wt% of $Nd_2O_3$ content, with the Sm/La is ration being higher than 1, whereas the average $Nd_2O_3$ content in Ce-monazite is 8-14 wt%. Three grains were identified as Nd-monazite. The chemical formula calculated for the grain with the highest Nd content is $(Nd_{0.449}Ce_{0.265}Sm_{0.093}Pr_{0.074}La_{0.060}Gd_{0.026}Y_{0.009})\Sigma_{0.976}Th_{0.003}$ $Ca_{0.036}(P_{0.986}Si_{0.014})_{1.000}O_4$. This is similar to the chemical formula reported for the Nd-monazites from Italy. It also shares the feature of having a relationship of the Sm>Pr>La content, instead of the La>Pr>Sm content, characteristic of the Nd-monazite from Greece. All Nd-monazites reported display Ce as the second most abundant element. Monazites from this study have Th contents spanning up to 8.72 wt%; $UO_2$ to 1.49 wt%; and PbO up to 0.79 wt%.

REE minerals rich in Nd or La are formed in strongly oxidizing environments, where $Ce^{2+}$ is turned into $Ce^{4+}$ and removed from the system. Nd-monazite crystals poor in Ce may crystallize from the resulting solution that is rich in middle REE ions (Sm-Nd-Pr-Gd). There have been reports on oxidizing alkaline brines in the Belt-Purcell Supergroup, associated with formation of diagenetic monazite grains [3].

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**References**

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