Magmatic fluid compositions relative to fluorine and chlorine in tungstenmineralizing intrusive systems

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A detailed examination of multiple intrusive phases comprising several Cretaceous-age granitoid intrusions in the Selwyn-Mackenzie Mountains, Northwest Territories (NWT), was conducted in order to compare and contrast magmatic fluid conditions in tungsten-mineralizing and non-tungsternmineralizing intrusive systems. The study area contains numerous W-Cu-(Mo-Au-Sb-Pb-Zn) mineral occurrences, and is best known for two world-class [1] tungsten skarn deposits: Cantung and Mactung. The focus of this study was to characterize magmatic fluid compositions in individual intrusions that could form skarn deposits and to use the data to identify specific intrusive phases that may have been responsible for supplying metals and volatiles to the tungsten mineralizing system. Volatile phases (F, Cl) were measured by electron-probe micro-analysis of magmatic and hydrothermal apatite, biotite, muscovite, and hornblende. Magmatic fluid compositions were approximated with relative ratios using HF, HCl, and H₂O activities calculated from mineral compositions following the methods of Zhu & Sverjensky [2].

Preliminary data from at least two tungsten mineralizing intrusions in the study area indicate that these systems are particularly enriched in F and depleted in Cl, and that volatile phases become progressively more enriched in F during cooling as the intrusive system evolves to more differentiated phases. However, samples most proximal to tungsten mineralization have relatively depleted F concentrations, and approximations of the $log(a_{HF}/a_{HCl})$ and $log(a_{HF}/a_{H2O})$ of the magmatic fluid for these samples are low in comparison to other, more distal intrusive phases. This indicates that a volatile phase was exsolved dominantly from the intrusive phases most proximal to mineralization, and that this exsolution probably occurred relatively early and at high temperatures (e.g., before apatite saturation: 750-900°C). These data suggest that potential economically significant and/or buried tungsten deposits may be targeted by examining the volatile constituents in magmatic minerals from prospective intrusions. Additional analyses and a more detailed examination of the data are underway for samples from the Cantung mine, as well as two barren intrusions in the study area. A complete discussion of the results of this study will be presented.

 Lentz (1998) Min. Assoc. of Canada Short Course Series
663. [2] Zhu & Sverjensky (1991, 1992) Geochim. Cosmochim. Acta 56, 3435-3467.

Geochemistry of Newania dolomite carbonatite, Rajasthan, India

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Of the twenty major Indian carbonatite complexes, Newania of Rajasthan is the only known "dolomite carbonatite". The most intriguing feature of Newania is that unlike most carbonatites it is not associated with alkaline silicate rocks. We have carried out field, geochemical and isotopic investigations of this 2.27 Ga old complex [1] with an aim to understand the origin and evolution of the complex, and the generation of carbonate magmas in general.

Field evidences suggest that Newania has seen multiple intrusive events. The intrusion of ankerite carbonatites appears to be coeval with the apatite mineralization event. Major and trace element concentrations indicate extensive fractional crystallization of the parental magmas. The trace element and REE patterns are akin to avarge carbonatites, except that the total contents are lower. $\delta^{18}O_{SMOW}$ of carbonate minerals shows a very large variation from 5.8 to 35 %, wheras $\delta^{13}C_{PDB}$ has a smaller spread from -5.6 to 0.9 ‰. In a $\delta^{13}C$ vs δ^{18} O covariation diagram most of the dolomite carbonatites plot in the "primary carbonatite" field [2], whereas most of the calcite/ankerite carbonatites have δ^{18} O > 15% indicating their altered nature. Multi-component Rayleigh fractionation model [2] suggests that the dolomite carbonatites have fractionally crystallized from a carbonate magma having initial compositions of $\delta^{13}C_{PDB} = -4.6$ and $\delta^{18}O_{SMOW} = 8.3 \pm 1.5$ % at a temperature of \sim 700°C. This implies that the mantle source compositions of the Newania carbonatites would have been: $\delta^{13}C_{PDB} = -4.6 \%$ and $\delta^{18}O_{SMOW} = 6.3 \%$ (2 % lower than that of the magma).

The $({}^{87}\text{Sr})^{86}\text{Sr})_i$ (0.701962 – 0.702316) and $\varepsilon_{Nd}(t)$ (1.7 – 7.4) of these carbonatites (calculated for an age of 2.27 Ga) support the field observations that there exists at least two generations of magmatic activity in the complex. The apatite rich (P₂O₅ > 10%) carbonatites have a higher (${}^{87}\text{Sr}/{}^{86}\text{Sr})_i$ and a lower $\varepsilon_{Nd}(t)$. The younger ankerite carbonatites (and apatite rich dolomite carbonatites) appears to have tapped an enriched (in LILE) mantle reservoir whereas the older ones are derived from a more primitive mantle.

[1] Schleicher *et al.* (1997) *Chem. Geol.* **140**, 261-273. [2] Ray & Ramesh (2000) *Geochim. Cosmochim. Acta* **64**, 299-306.