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Technical note

Study the relationship between the compositional zoning of high iron content pyrochlore and adsorption of cationic collector

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ABSTRACT

The matrix composition and surface chemistry of high iron pyrochlore (Fe pyrochlore) grains from Niobec (St-Horone carbonatite deposit) were analyzed, in order to identify a potential relationship between Fe pyrochlore matrix composition and the related effect on cationic collector adsorption (tallow diamine). SEM–EDX analyses indicate compositional zoning in the structure Fe pyrochlores. TOF-SIMS was used to analyse the surface of different compositional zones of Fe pyrochlore, in order to identify their related effects on tallow diamine adsorption. Surface analyses of high and low iron zones of treated Fe pyrochlore show that species indicative of the collector favour the regions of low iron content The low iron areas also show a lower relative proportion of species indicative of oxidation. This study identifies the link between Fe pyrochlore compositional zoning, surface oxidation and, area selective collector loading.

1. Introduction

In North American, Niobec is the only operating Nb extraction facility which has recovered pyrochlore ($(Na,Ca)_2Nb_2O_6(OH,F)$), the most abundant niobium containing mineral, from the St-Honoré carbonatite deposit by froth flotation. In Niobec plant, the pyrochlore surfaces in the desired pH (6–7) flotation range were negatively charged and therefore flotation of the pyrochlore was accomplished by the cationic collector, tallow diamine acetate (Dufresne and Goyette, 2004; Belzile, 2009).

Poor flotation of high iron pyrochlore is noted in the plant (Rao et al., 1988; Chehreh Chelgani et al., 2012a). Investigations indicated that the Fe increase in the pyrochlore is not as a result of Fe rich inclusions, rather it has been identified as an increase in matrix Fe content, and also suggested that poor floatability is linked to higher matrix Fe content (Chehreh Chelgani et al., 2012a). Surface chemical analyses of high and low iron pyrochlores by TOF-SIMS verified a relationship between pryochlore surface reactivity and Fe content in the mineral matrix, and demonstrated the intensity of collector species was significantly higher on the surface of the Fe poor pyrochlore. Surface analyses released that the flotation selectivity of low Fe pyrochlore grains relative to high Fe pyrochlore grains, was in response to surface oxidation of the high Fe pyrochlore resulting in diminished collector attachment and poor recovery (Chehreh Chelgani et al., 2012b).

Zonation in pyrochlore ($A_2B_2O_7$) mineral groups is well recognized but less well understood. This is due, in part, from failure to recognize secondary alteration (replacement) phenomena and to distinguish them from primary (growth) features (Sharygin et al., 2009). Lumpkin and Ewing (1995, 1996) described alteration trends in pyrochlore from a range of parageneses and weathering environments. They identified three trends relating to alteration "primary", "transitional", and "secondary". The distinction is compositionally related, using triangular diagrams with apices corresponding to divalent A-site cations (Zurevinski and Mitchell, 2004).

In this study, the relationship between compositional zoning and surface chemistry of high iron pyrochlore grains from the Niobec deposit were investigated. To the authors' knowledge, it is the first record of compositional zoning in Fe pyrochlore for St Horone deposit. This work describes zoning and chemistry of the Fe pyrochlore mineral, which is the main source of Nb. The study utilised energy dispersive X-ray spectroscopy (EDX) to measure concentrations of the main matrix elements in zoned areas of Fe pyrochlore grains which ultimately will affect the surface chemistry and factors controlling collector attachment. Time of flight secondary ion mass spectroscopy (TOF-SIMS) analyses were performed to examine the surface chemistry of Fe pyrochlore grains from the various areas in order to identify variability in reagent adsorption along with possible factors affecting the absorption. The main aim of this study is to link pyrochlore matrix composition to surface chemistry in an attempt to relate the noted

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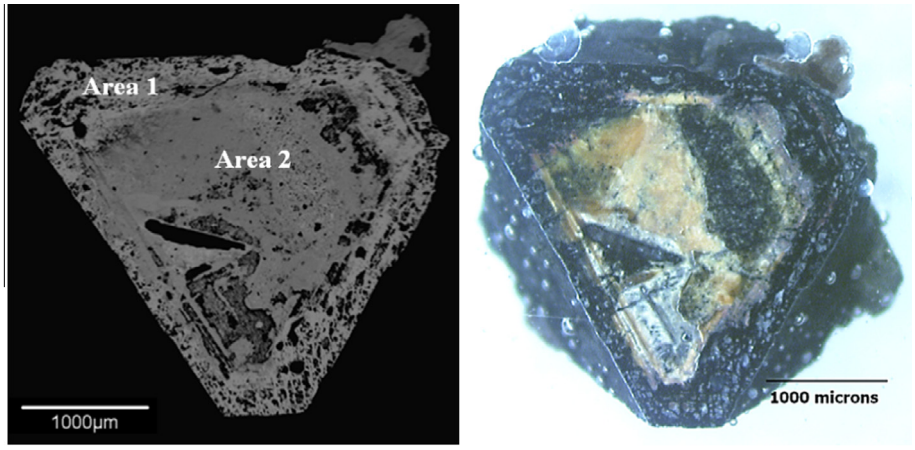

	O	F	Na	Al	Ca	Ti	Fe	Sr	Nb	Ag
Area 1	35.89	*MDL	0.65	0.42	0.77	3.19	15.22	1.52	41.65	0.7
Area 2	36.3	2.35	4.63	0.44	12.93	2.54	0.43	2.14	37.7	0.54

*MDL: Method detection limits, elements may be present but are below for detection.

Fig. 1. Optical microscopic (right) and BSE images (left), and EDX analysis of a Fe pyrochlore grain at wt.%.

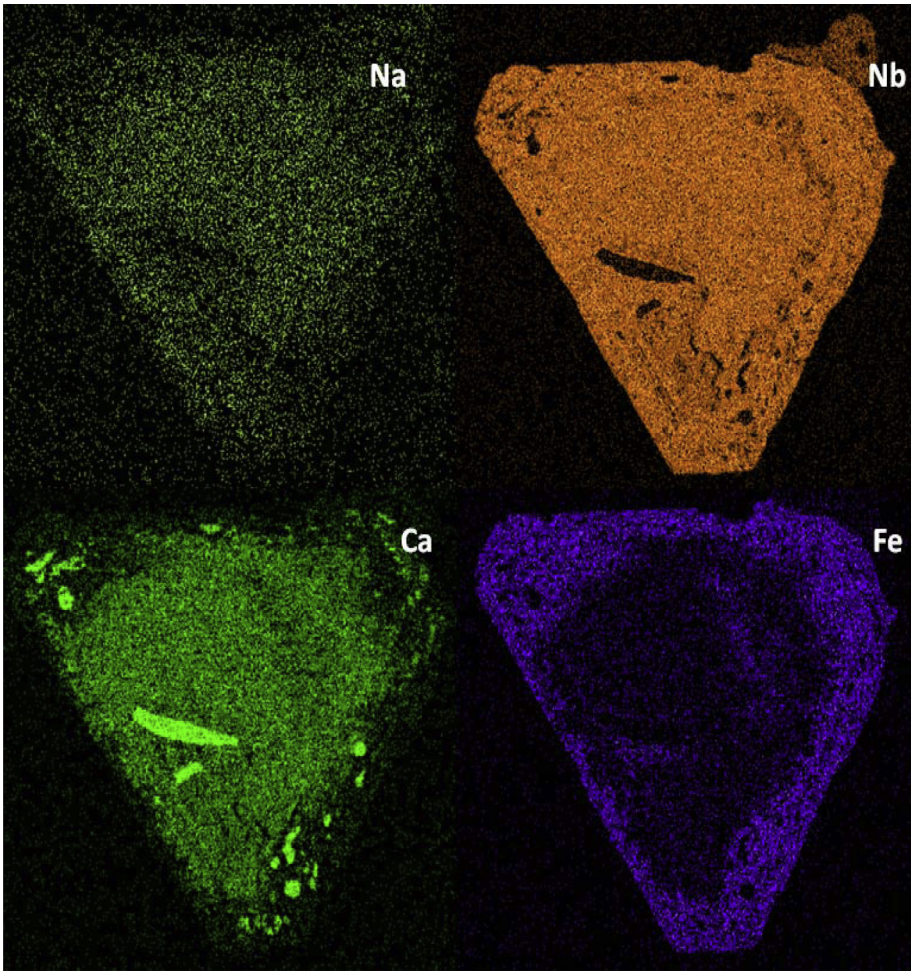

Fig. 2. Elemental maps for zoned crystal of the Fe-pyrochlore for St-Horone deposit.

variability in flotation recovery to compositional zoning. The results will be used to better understand the effect of compositional zoning on collector loading, the collector adsorption mechanism, and selective flotation.

2. Experimental

The concentration of matrix elements were measured in the Fe pyrochlore grains with a LEO 440 SEM equipped with a Gresham