INTRODUCTION

Magmatic Na-rich phlogopite (e.g., Na$_2$O > 1 wt%) is an unusual mineral. Up to now, it has been recognized almost exclusively as an accessory mineral occurring in minute mono- or polymineralic inclusions in chromites of mafic layered intrusions (see Table 1; Irvine 1975; Morette et al. 1984; Talkington et al. 1986; Lorand and Cottin 1987), and ophiolite complexes (Augé 1987; Peng et al. 1995; Arai et al. 1997; Schiano et al. 1997). The only occurrence of Na-rich phlogopite not included in chromite was reported by Price and Sinton (1978) in the granitoid-gabbro suite of the Longwoods Complex, New Zealand. Aspidolite (recently resurrected by the International Mineralogical Association, is synonymous with the end-member Na phlogopite; Rieder et al. 1998) is commonly found in association with phlogopite, olivine, pyroxene, albite, feldspathoids, and Na-rich amphibole, and has been interpreted as the result of open-system processes involving infiltration of water-rich evolved melts [with high Na/(Na + K)] and reaction with refractory minerals. The highest 100·Na/(Na + K) (~70) and Na$_2$O concentrations (~5 wt%) in phlogopite appear to require reaction with liquids of unrealistically high Na/(Na + K) if no other factor is considered. This, together with the observation that phlogopites consist of alternating Na-rich and Na-poor cleavage-parallel bands, can be best interpreted by the presence of a solvus between the aspidolite (Na) and phlogopite (K) end-members. The high proportions (up to 15 vol%) of Na-rich phlogopite in two different groups of gabbroic xenoliths suggest that it might be a more common and abundant mineral than has been previously recognized, and that it may be used as an indicator of open-system processes.

GEOLOGICAL SETTING

Holocene Volcán San Pedro is the youngest and most prominent volcanic edifice (3621 m) of the Quaternary Tatara-San Pedro Complex (~55 km$^2$; TSPC), which is located on the volcanic front of the Southern Volcanic Zone of the Andes, at 36º S, 71º51’W (Singer et al. 1997). The TSPC comprises roughly 1 m.y. of volcanic activity, consisting mainly of lavas ranging from basalt to rhyolite that define medium- to high-K calc-alkaline trends (see Fig. 6 of Singer et al. 1997). The magmatic activity at Volcán San Pedro is divided into a cone-building phase comprising andesitic and dacitic lavas, and a younger phase that post-dates the sector collapse of the eastern flank of the volcano, which was accompanied by an explosive eruption that produced dacitic air-fall deposits (Singer and Dungan 1992). This was followed by the eruption of a sequence of lava flows that apparently records the downward tapping of a strongly zoned magma chamber. The eruptive sequence includes: (1) 0.2 km$^3$ of biotite-hornblende dacite containing abundant gabbroic xenoliths (up to 45 cm in diameter) and