INTRODUCTION

The stability of phlogopite in granulite facies rocks has long been in doubt, and it has been generally assumed that this mineral forms during retrograde hydration of earlier high-temperature anhydrous assemblages (e.g., Ellis et al. 1980). Some studies on high-grade terranes (e.g., Grew 1982; Mouri et al. 1996), and a number of recent experimental investigations (Dooley and Patiño Douce 1996; Hensen and Osanai 1994; Peterson et al. 1991) have drawn attention to the influence of F (and Ti) in extending phlogopite (and biotite) stability, and the likelihood of stable persistence of F-rich phlogopite to very high temperature. In this paper, we describe phlogopite from the Napier Complex in Enderby Land, East Antarctica, with significantly higher F-content than so far reported for metapelites.

Natural F-rich phlogopite with more than 8 wt% F is very rare and has so far only been reported from calc-silicates. Phlogopite with up to 8.53 wt% F has been described in granulite-facies marbles from the Adirondacks (Petersen et al. 1982; Valley et al. 1982), and phlogopite with 7.13 wt% has been described from similar rocks in New Jersey (Yau et al. 1984). In pelitic rocks from high-temperature (and some UHT) terranes, F-bearing biotite has also been found, but with F-contents not exceeding 4.2 wt%, e.g., the Arunta Block in Australia (Warren and Hensen 1987), Grenville Province in Canada (Arima and Gower 1991), In Ouzzal in Algeria (Mouri et al. 1996), Assam (Lal et al. 1987), Karnataka and Tamil Nadu (Janardhan et al. 1982), Kerala (Chacko et al. 1987) and Palni Hills (Raith et al. 1997) in India, Namaqualand in South Africa (Waters 1988), Vestfold Hills (Harley 1993) and Forefinger Point (Harley et al. 1990) in Antarctica. The highest value so far reported (5–6 wt%; Grew 1982) is also in a sample from the Napier Complex.

The Napier Complex is an ultra-high-temperature (UHT) metamorphic terrane that has undergone 980–1120 °C temperature metamorphism (e.g., Harley and Hensen 1990; Harley and Motoyoshi 2000). Mineral assemblages indicative of such extreme temperatures, which occur on a regional scale, include sapphirine + quartz, orthopyroxene + sillimanite + quartz, spinel + quartz, and osumilite + garnet in metapelitic rocks (Dallwitz 1968; Ellis 1980; Ellis et al. 1980; Grew 1980, 1982; Sheraton et al. 1980). Moreover, the scarcity of hydrous minerals, and the apparent lack of extensive partial melting, suggest that the water activity (aH2O) was very low during metamorphism (references above). In addition to the anhydrous minerals, however, rare biotite has been described (Ellis et al. 1980; Grew 1980, 1982; Sheraton et al. 1980). Although most of the biotite is of secondary origin and formed by lower-temperature hydration (Ellis et al. 1980), some biotite appears to be primary (Sheraton et al. 1980; Grew 1980, 1982). Grew (1982) suggested that biotite in osumilite-bearing rocks from Mount Dungey, which is rich in TiO2 (~4.3 wt%) and F (~5.3 wt%), was stabilized by these components. He also considered F-free phlogopite breakdown leading to osumilite formation in the KMASH system.

We report the occurrence of F-rich phlogopite with up to 8.2 wt% F and, consequently, with very little OH in an osumilite-orthopyroxene-sapphirine granulite from Mt. Riiser-Larsen (Fig. 1). We describe the textural context and mineral...