Whole-rock geochemistry and fluid inclusions as exploration tools for mineral deposits assessment in the Serre batholith, Calabria, southern Italy

BENEDETTO DE VIVO*, ROBERT A. AYUSO**, HARVEY E. BELKIN**, ANNAMARIA LIMA*, ANTONIA MESSINA***, SELMA RUSSO*** and ANNA VISCARDI*

*Dipartimento di Geofisica e Vulcanologia, Largo S. Marcellino 10, I-80138 Napoli, Italia
**U.S. Geol. Survey, 22092 Reston, Virginia, USA
***Istituto di Scienze della Terra, S. Agata-Papardo, I-98166 Messina, Italia

Abstract: Field and geochemical studies of granitic plutons belonging to the Serre batholith, in southern Calabria, show that some of these plutons are associated with minor molybdenite, base-metal occurrences, and granitophile geochemical anomalies. The results of a geochemical survey of granitic bedrock and treatment of the data by statistical techniques indicate a grouping of geochemically anomalous samples, with clusters of high R-mode factor scores that identify potential hosts of significant granite-related mineralization, especially Mo, Sn, and W. Especially favourable hosts are siliceous and generally potassic differentiated granitic rocks, especially near the village of San Todaro, and near Bagni di Guida, Monte Cola, Monte Crocco and Mongiana. These areas are candidates for more detailed exploration, as they contain clustering of significant geochemical anomalies for Mo, Rb, W, Cu, Nb, etc., and more importantly, these granites are known to host base-metal sulphide veins. Granite specialization indices for (Rb/Sr>5, K/Rb<200 and Rb³Sr·K/0.1) are also typical of granitic rocks hosting base-metal and granitophile mineralization; high-factor scores for the associations K-Rb-Ba-Al-Pb, Nb-Sn, Pb-Sn and Cu-Sn are also found.

Intrusive rocks from the Serre batholith, and from the nearby Sila batholith, in northern Calabria, have similar fluid inclusion features; both contain fluid inclusions that resemble those from granites known to show mineralization elsewhere. A common characteristic of inclusions in Sn-bearing granitic rocks and those in the Serre batholith is the correlation between homogenization temperature and salinity, suggesting mixing of magmatic saline fluids with cooler, lower salinity meteoric waters. There is no evidence, however, that vigorous, voluminous, and intense alteration by boiling and high salinity hydrothermal systems were developed in the Serre batholith. Sulphide-bearing veins near Bagni di Guida and San Todaro, two of the most important areas identified in this study as potential hosts, probably reflect episodic tectonic adjustments that momentarily dropped the pressure from lithostatic to hydrostatic, producing boiling and minor hydrothermal alteration. Known sulphide occurrences in the Serre batholith are thus unlikely to be expressions of a major hydrothermal alteration and mineralization system, unless the occurrences represent the distal effects of such a system.

Key-words: fluid inclusions, lithogeochemistry, mineral exploration, Serre batholith, Calabria.

1. Introduction

Late Variscan granitic plutons in the Serre Massif (Fig. 1), in the southern sector of the Calabrian-Peloritan Arc, were studied to determine their potential as hosts of base- and rare-metal granitophile deposits. The intrusions belong to two distinct Alpine tectonic units (thrust sheets), Polia Copanello and Stilo (Amodio Morelli et al., 1976; Maccarrone et al., 1983; Bonardi et al., 1984 and reference therein) but according to Crisci et al.(1985), Del Moro et al. (1986) they are best described as belonging to a single Alpine tectonic unit.

The granitic rocks form a batholith composed of discrete and sharply bounded plutons.