chiefly related to the relative volumes of the two components, to their compositions, and to their physical properties (e.g. temperature and viscosity). During crystallization of the magmas, mixing mechanisms change because these factors vary.

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BARBARIN B.* - *Use of zircon typology to solve some granite problems in the Massif Central (France)*

Use of the zircon morphology method (PUPIN 1976 & 1980) facilitates solution of several kinds of regional problems related to the petrology of granites in the Massif Central. This method, based on the relative development of the main faces of zircon crystal, is simple, fast, and relatively economic.

The zircon method commonly reveals a determinant argument or represents an additional constraint in comparing granites exposed in the same area. Thus, this method permitted distinction between the Margeride porphyritic monzogranite with its various facies and the other porphyroid granitoids surrounding the Margeride laccolith (LABOUE, 1982). Zircon morphology also indicates that the enclaves of porphyritic granitoids enclosed in the nearby and younger Velay pluton do not represent fragments of the Margeride porphyritic monzogranite, but of other, distinct porphyritic granitoids (PUPIN, 1976; DE MONTRAVEL, 1987). In another case, this method showed the identity of two plutons displaced by a major thrust fault (the Gelles and the Meymac porphyroid monzogranites displaced by the Sillon Houllier; MEZURE & NÉGRONI 1983).

Furthermore, study of many populations from the same pluton gives an indication of temperature and composition changes in the magma during crystallization. In the Hermitage two-mica granite (Forez), similar variations are obtained from the populations of the contrasted facies of the pluton and from the successive zones visible in single crystals (BARBARIN, 1983).

Study of zircons can also provide a general outline of the magmatism in a large granitic area. Thus, typologic study of zircon populations from the Forez granitic horts allows the different plutons to be grouped into two main types, one formed of hybrid granites and the other formed of crustal granites (BARBARIN, 1983 & 1984).

These data indicate that the zircon morphology method is a convenient and useful tool in granite petrology. It complements the petrographic and geochemical methods, and often plays a fundamental role in either relating and discriminating between plutons. It can be applied to a few granite plutons or to a larger area such as the Forez Mountain or the entire Massif Central (PUPIN, 1985).

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BATINI F.*, BERTINI G.*, DINI I.*, GIANELLI G.**, NICOLICH R.***, PANDELI E.*, PUXEDDU M.** - *Geological model of the Monte Amiata volcano-plutonic system (Italy)*

Geological, geophysical and petrologic data point to the presence of a granitic body below geothermal region of Monte Amiata (Central Italy).

1) Geological data: a broad area of about 900-1300 km² centered on Monte Amiata volcano shows a remarkable regional uplift of the Pliocene shore

Fig. 1. 1) Quaternary Volcanics. 2) Lower Pliocene sediments. 3) Upper Miocene sediments. 4) Ligurid flysch complex. 5) Tuscan Nappe. 6) Minium uplift of Mio-pliocene sediments. 7) Gravimetric profiles.

Fig. 2

sediments up to 950 m (Fig. 1). The extend of the area, with major axes of 25-30 km (NW-SE) and 45-50 km (NE-SW), is consistent with the emplacement of a large intrusive body in shallow levels of the crust. The uplift begum during lower Pliocene, with a prograde regression

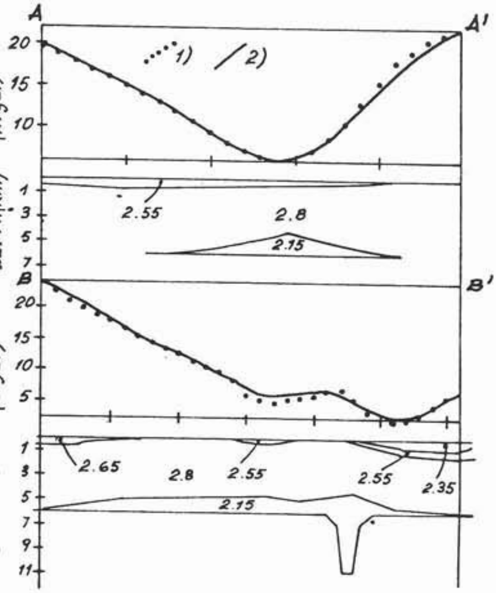

Fig. 3. Gravity profiles: traces in Fig. 1. 1: calculated gravity. 2: measured gravity.

of the Pliocene sea from an uplifted area centered in the volcano zone. The temperature distribution below the Piancastagnaio field shows an updoming of the isotherm. This thermal high is not related only to the present-day hydrothermal circulation, but was probably present during a previous stage of contact matamorphism, as demonstrated by the distribution pattern of post-tectonic green biotite in the basement rocks. Moreover wollastonite + diopside + epidote + K-felspar were found replacing the primary paragenesis of carbonatic quartz-phyllite ejected during a well blow-out from a depth of 3242 m b.g.l. (PC34 well), 2-4 km above the top of the granite intrusion. Assuming a pressure of 850 bar and a XCO_2 of at least 0.17 by analogy with the present-day computed PCO_2 in the deep levels of the Piancastagenaio area, we obtain a minimum temperature pof formation of 500°-550°C, that indicates a fast rise of hot fluids along major faults.

2) Petrologic data: a re-evaluation of the petrographic data from the xenoliths present in the Monte Amiata volcanic products (VAN BERGEN, 1983) allowed an estimate of the P-T conditions of the magma body. For this purpose we computed in a P-T diagram the equilibrium conditions for the following reactions (Fig. 2): 1) andalusite ⇄ sillimanite; 2) annite + qz + 1/3 O_2 ⇄ fay + 1/6 Fe_3O_4 + san + H_2O; 3) Mg-Fe chl (X_{Mg}chl = 0.43) ⇄ Mg-Fe crd + Mg-Fe ol + Fe spinel + H_2O; 4) mu + qz ⇄ san + Al_2SiO_5; 5) mu ⇄ san + Al_2O_3 + H_2O; 6) bi (X_{An} = 0.5) + qz + 1/3 O_2 ⇄ ol (X_{Fa} = 0.6) + Fe_3O_4 + san + H_2O; 7) Mg chl ⇄ Mg crd + fo + spinel + H_2O, consistent with the chemistry and mineral composition of the xenoliths. A minimum T of 575°C and pressure of 1550-2200 bars can be estimated for the confining rocks around the magma body (see shaded area in Fig. 2). Magmatologic data on the rhyodacitic magma of Monte Amiata show a T of 800°-900°C and a P (load) > P(H_2O) = 1000 bar (BALDUCCI & LEONI, 1981). Therefore the roof of the magma body should be present at about 6 km depth.

3) Geophysical data: seismic reflection data reveal the continous and widespread occurrence of a reflecting horizon (K) of the «bright-spot» type all over the geothermal region and for a distance of more than 10-12 km along the profile PIA16, ending near Piancastagnaio. This horizon is present at a depth of 5-6 km. By analogy with Larderello we inerpret the K-horizon as a fractured interval filled with hot fluids, contact metamorphic and hydrothermal minerals, generated (during granite intrusion) in the uppermost part of the granite and the basal levels of the wall-rocks. The strong variation of the acoustic impedance is enhanced by the possible presence of high melt fractions in the intrusive body. In fact considering the very slow cooling rate of the Tuscan intrusions (15°-20° C/Ma, at Larderello, DEL MORO et al., 1982) the young age od the Monte Amiata volcanics (0.18-0.29 Ma, BIGAZZI et al., 1981) and magmatologic data, it can be concluded that the intrusive body has a today temperature of about 800°-820°C and a melt fraction of 60-65% and a computed density of 2.15 g/cm³. By integrating geophysical and geological data a bidimensional gravimetric model of the volcano-plutonic system of Monte Amiata (Fig. 3) is proposed, with the following features: roof depth = 5-6 km, T = 820°C, d (magma) = 2.15 g/cm³, d (wall rock) = 2.8 g/cm³, shape of intrusion = lens shaped or mushoroomlike with possible thickening and roots just below Piancastagnaio. This model fits very well the gravimetric data, that show a negative anomaly in corrispondence with the uplifted area.

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BELLIENI G.*, CAVAZZINI G.**, FIORETTI A.M.**, PECCERILLO A.***, POLI G.**** - *The role of crystal fractionation, AFC and crustal melting in the genesis of the Rensen Massif (Eastern Alps. Italy)*

The Rensen Massif is a Late Alpine (about 30 ma-old) plutonic complex sited in the Eastern Alps. It consists of rock types range in composition from diorite to granite. These make up a typical calc-alkaline series which display smooth major element variations consistent with a genesis by crystal fractionation. Sr isotope ratios and trace elements abundances of representative samples do not support this hypothesis and suggest more complex genetic processes. Initial $^{87}Sr/^{86}Sr$ ratio ranges from 0.70766 to 0.70886 in the diorite-granodiorite range whereas it atteins values of 0.71008 to 0.71078 in