

F-AND B-RICH GRANITE FROM AN ACTIVE GEOTHERMAL FIELD IN ITALY

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In the geothermal region of Larderello (Italy) all the geophysical data are consistent with the occurrence of granitic intrusions, possibly a composite batholith, rooted in the mantle and rising at 3-10 km depth, with a 25-40 km diameter. These data led to the conclusion that acidic magma, and/or fluids derived from magma are present at relatively shallow depth. Geochronological data indicate that the batholith underwent a slow monotonic cooling since 4 Ma ago. The igneous rocks found so far in the deep well drilled in the field at 3-4.6 km depth are high-Al, S-type granite with important F and B content. Their composition ranges from monzogranite to differentiated leucogranite highly enriched in incompatible elements. Fluid inclusions in granite and contact metamorphic rocks are characterised by the presence of LiCl. It has been estimated that the present melting conditions for some leucogranitic rocks of Larderello can occur at approximately 6 km depth in many parts of the geothermal field, where the geothermal gradient is about 100°C/km. This conclusion is based on the fact that the original load pressure of a shallow granite dyke at 3483 m depth can be estimated to be 110-120 MPa, considering an uplift rate of approximately 800 m in the last 4 Ma. The occurrence of muscovite in the granite at such low pressures (muscovite is not stable at $P < 350$ MPa in water-saturated granites) can be explained by the presence of B, F and Li in the magma. Since these elements shift the granite solidus towards low T values, the granite solidus could intersect the curve of the muscovite at approximately 600°C. The petrology of the Larderello batholith shows strikingly analogies with the Cornwall batholith and suggests the occurrence of a particular magmatic province.