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Variscan thermal anomaly highlighted by coeval Limousin magmatism and metamorphism

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Granitoid magmatism plays an especially visible role in the Variscan Orogeny of Europe, where voluminous granitoid magmas were emplaced between 360 and 270 Ma. The Variscan Massif Central, France, is a collision belt that first experienced crustal stacking and thickening followed by extension and thinning. This region, now deeply eroded, is characterised by many granites that in the Massif Central comprise nearly 50% of the outcrops. The Variscan granite plutons in the Limousin region are spatially associated with major synmagmatic strike-slip shear zones that merge to the northwest with the South Armorican Shear Zone. Previous investigations have emphasized the role of late-orogenic extension in the emplacement of granite plutons in the Limousin region, but new U/Pb monazite and microstructural data on mylonitic leucogranite indicate that they were emplaced and sheared in dextral transpression at 313 ± 4 Ma, coeval with high-grade metamorphism of host micaschist. U/Pb data are similar to $^{40}Ar/^{39}Ar$ data from biotite and muscovite in C-S structures of the mylonitic leucogranites. These geo/thermochronology data indicate that the leucogranites experienced rapid cooling (30˚C/Ma) between 750˚C and 300˚C.

The 3-D shape at depth of these granite bodies, investigated using gravity modelling, is that of laccoliths, < 4 km thick. To explain the large aspect ratio of the Limousin plutons and their large horizontal extent, we propose that vertical shear zones may have helped channel magmas from a deep source to their middle crust emplacement level. Then, magmas were trapped along the subhorizontal micaschist foliation.

Integrated structural data suggest that the Limousin region was a ductile, right-lateral, wrenching pop-up structure within which granitic magmas were channelled. The Galician region, in the western end of the Ibero-Armorican tectonic arc, contains major left-lateral ductile shear zones associated with voluminous granite magmatism and these can be interpreted as conjugate structures to the Limousin and Armorican shear zones.