Geophysical Research Abstracts
Vol. 20, EGU2018-17017, 2018
EGU General Assembly 2018

Insights into the source, evolution and emplacement of continental arc magmatism from the Northern Igneous Complex of Guernsey, Channel Islands

Andrew James Whyte, Sami Mikhail, and Richard White
School of Earth and Environmental Sciences, University of St Andrews, St Andrews, United Kingdom
(ajw33@st-andrews.ac.uk)

Subduction-driven continental arcs are a major contributor to global volcanism and magmatism. Subduction-induced magmatism (or arc magmatism) has a prominent effect on the upper lithosphere – through upward migration of large volumes of magma, and the introduction of evolved mantle-derived melts to the crust – so it is important to understand the conditions and processes that produce these magmas. Because of their strong imprint on the crustal rock record, studying these magmatic rocks is a sound approach to evaluating the influence of subduction on continental growth and lithospheric evolution.
To reveal the impacts of arc magmatism on the overriding lithosphere, we have studied the exposed remnants of crustal plutons in Guernsey formed during Neoproterozoic, Andean-style subduction. The Cadomian Orogeny, active from c. 700 to 425 Ma, represents convergent tectonism associated with a south-dipping subduction zone in which oceanic crust subducted below Gondwana at the southern margin of the Iapetus Ocean.
Field observations on Guernsey highlight aspects of this magmatism such as: the range of magmatic compositions produced, with gabbro, diorite, granodiorite and granite bodies present; the emplacement depth of greater than c. 3 km below the surface indicated by coarse average crystal sizes in all plutons; and the contemporaneous existence of compositionally different magmas indicated by spectacular mingling textures, suggesting that magmas evolved in deeper staging chambers prior to their injection at the level observed.
A 1:10,000 scale geological map of the Northern Igneous Complex was produced to provide context for detailed petrography and chemical analysis, from which equilibrium-phase relationships and trace-element behaviour in the complex were established. This information elucidates the melt sources and magmatic processes relating to individual batches of magma, and feeds phase-equilibrium models that reflect the thermobarometric properties of the complex during its solidification. We present the results of this coupled approach that describe the source, evolution and emplacement of continental arc magmas, and thus allow their impact on continental lithosphere to be better understood.