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Periodicity in magmatic systems

Luca Caricchi
University of Geneva, Department Earth Sciences, Geneva, Switzerland (luca.caricchi@unige.ch)

Magmatic systems show periodicity in productivity, magma chemistry and dynamics of volcanic eruptions. The timescales over which such parameters change are highly variable and ranges between several tens of millions of years down to few hundredths of thousands years. While magmatic activity appears modulated at various frequencies, the lifetime of single volcanic systems, the duration of emplacement of single plutons, or the timespan over which a given volcanic region is active, appear to last for distinct but characteristic periods of time. Hundredths of thousands of years is a typical number for the range of zircon crystallisation ages in the products of large eruptions or for the lifetime of single plutons, while activity in volcanic regions or the duration of emplacement of crustal batholiths appears to last up to about 10 Ma.

Several mechanisms such as variable magma productivity in the mantle, delamination, thermal and mechanical maturation of the crust have been proposed to modulate magmatic activity. All these processes indeed contribute to modulate the periodicity of magmatic activity, but because certain timescales are recurrent, some fundamental processes must play a fundamental role in regulating the "tempo" of magmatism. Are transitions of behaviour finally the product of major changes in mantle dynamics or is the crust the plays the pivotal role in modulating periodic variations observed in magmatic systems?

In this contribution I will provide an overview of existing data on periodicity of magmatic systems and use thermal modelling to show that periodic variations of magma chemistry and the physical properties of magmas are an inexorable consequence of the evolution of the thermal budget of magmatic systems. I hope to trigger discussion and collaborations between experts of geodynamics and magmatism to establish relationships between periodicity, mantle and crustal processes.