# Causes of pulsed mineral growth during metamorphism

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A growing set of observations suggests that metamorphic processes and conditions frequently are pulsed or episodic in nature rather than steady and long-lived. We recognize a "pulse" as any process, condition, or manifestation thereof that persists or dramatically accelerates for a brief period of time (relative to the general timescale of background tectonic/geologic forcing). Such pulses may include some or all of the following, which may not always be genetically linked: increased temperature, fluid influx, magmatism, and deformation, any of which may also promote mineral growth (and thus potentially be recorded therein).

Mineral growth pulses can have different causes. We describe three end-member possibilities here. First, rapid changes in *P* or *T* can drive more rapid mineral growth by quickly moving rocks through sets of reaction isopleths requiring compositional or modal change. Thermal pulses require mechanisms for rapid heating followed by focused heat dissipation, not possible via conductive heat transfer alone. For example, advective heat flow, provided by migrating syn-orogenic magmas and/or related fluids can contribute to thermal pulses. Or, rapid changes in P (and T) may accompany deformation during vertical motion in shear zones or thrusts. Second, steadily changing *P* and *T* can also produce pulsed mineral growth if reaction isopleths become closely (and/or orthogonally) spaced along portions of the *P-T* path. Third, a kinetic trigger (such as the introduction of a catalyzing fluid, which itself may be related to a pulse of dehydration or deformation) can permit a thermodynamically overstepped reaction to suddenly activate. Using vividly documented examples of mineral growth pulses [1,2] and thermal pulses [3], we explore different pulses, their possible causes, and the likely extent of their interactions.

[1] Pollington & Baxter (2010) *EPSL* **293**, 63-71. [2] Dragovic *et al*. (2011) *Goldschmidt Conference, Prague*. [3] Ague & Baxter (2007) *EPSL* **261**, 500-516.

# A global distribution map for Nd isotopes in European watersheds

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The Nd isotopic composition of the detrital fraction of a sediment provides information on the geographical provenance of that material. Aplication of the $\varepsilon_{Nd}$ proxy to sedimentary records can be used to deduce sediment input variations, and hence to constrain fluctuations in transport mechanism.

In this study, we have compiled literature data for Nd isotopes in river sediments from all over Europe. This compilation was completed by analysing an extensive series of fine-grained sediments collected from various european rivers, estuaries, upper continental shelves and endorheic basins. For each sediment, the obtained $\varepsilon_{Nd}$ value was taken as representative of the corresponding drainage basin signature. The result of this work is a global distribution map for Nd isotopes in european watersheds, which covers about 70% of the continent.

Based upon this map, we will discuss on the potential of using Nd isotopes for adressing some of the key issues related to the Late Quaternary environmental history of Europe.