# Testing the thermal state of Biella pluton country rocks via numerical model of magma cooling

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**Abstract:**

The Biella pluton (30-31 Ma) is a Periadriatic intrusive of the Alps, emplaced in the internal part of the HP continental Sesia Lanzo Zone (Berger et al., 2012). Pluton cooling involved contact metamorphism overprinting eclogitic to greenschist facies assemblages in country rocks. Multiscale structural analysis combined with thermos-barometric estimates suggest that magma intrusion took place at shallow crustal levels (Zanoni et al., 2008; Zanoni et al., 2010; Zanoni, 2015).

The emplacement history indicates that the intrusion of Biella body occurred when the Sesia Lanzo Zone had almost completed its exhumation under low thermal state consistent with an ongoing subduction (e.g. Roda et al., 2012 and refs therein). The mechanism proposed for triggering the Periadriatic magmatism are either subduction (Tiepolo et al., 2014) or slab break-off (e.g. Von Blankenburg & Davies, 1995). However recent numerical modeling (Freeburn et al., 2015) suggests that a slab break-off related melting does not result in the widespread magmatism characterizing many collisional belts.

In order to unravel the thermal state of the Biella stock country rocks at the intrusion time we develop a preliminary 2D thermal model of pluton cooling testing four different thermal gradients of the host rocks. We compare the extent and the variation in the thermal peak of the contact aureole recorded in the country rock (Fig. 1) with the results of the numerical simulations.

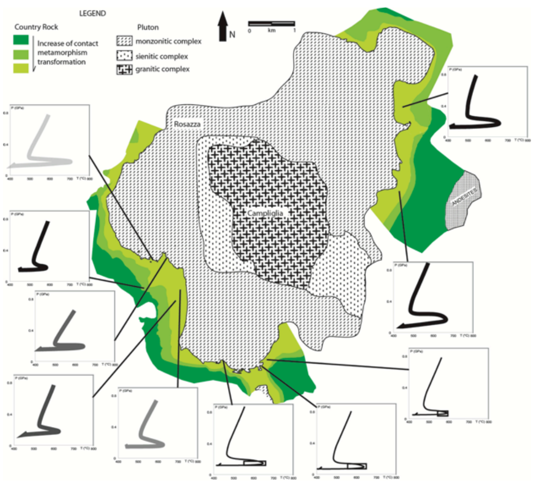


*Figure 1: Summary of P-T evolution in Biella aureole at different distances from the pluton margin. Thick line: P-T from calculated petrogenetic grids; thin line: P-T from independent thermobarometry only.*

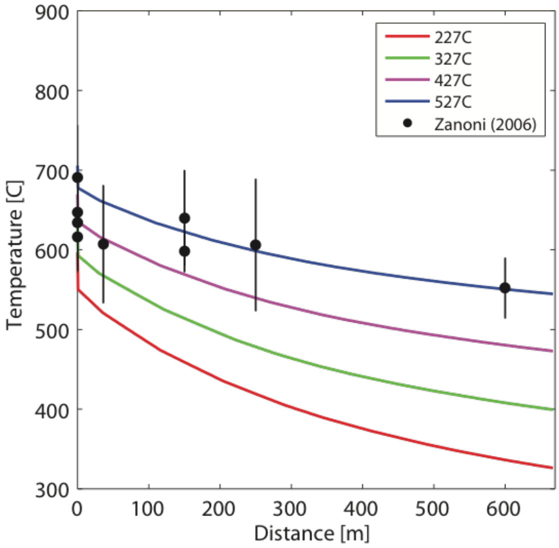


*Figure 2: Spatial distribution of $T_{max}$ due to heat conduction from the pluton to host rock for different base temperatures (lines) and comparison with natural data (dots).*

The computed thermal boundary of the aureole is between 300 and 400°C and is wider than the mapped one due to the difficulty to distinguish between contact and greenschists regional metamorphism at such low temperatures. The best fit occurs for the simulation accounting for temperatures between 427 and 527°C (700 and 800 K) at 8 km depth (Fig. 2), assuming conduction as the only effective heat transfer mechanism. This indicates that the emplacement occurred under thermal gradients between 55 and 65°C/km that would exclude a syn-subductive magmatism. The suggested thermal gradient for the country rock of the Biella pluton would represent the constraint for testing different scenarios responsible for the generation of Periadriatic magmatism.

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