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### The Lower Permian Alpigia magmatic complex and its country rock (Upper Maggia Valley, Central Alps): petrology, geochronology and structural position

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The Alpe d'Alpigia is located in the Upper Maggia valley (Ticino) west of the village of Fusio in the Lepontine dome of the Central Alps. It consists of a metamorphosed mafic to intermediate magmatic complex subdivided into a meso- to leucocratic "Alpigia Gneiss" and a darker gabbroic facies on the 1:25'000 geological map of Keller et al. (1980). This complex is intruding a series of banded amphibolites, as well as ortho- and paragneisses. The structural position of the Alpe d'Alpigia is disputed for many years (review in Steck et al. 2013), as it is located at the convergence point of four structural units: the Maggia, Sambuco, Simano and Antigorio nappes. No decisive field observation has been put forward so far to solve this dilemma. A potential approach is to date the Alpigia magmatic complex and to compare its age with that of magmatic events in the surrounding tectonic units. Although not decisive, this criterion added to existing stratigraphic and structural data could help solving the problem.

The Alpigia complex is a calc-alkaline magmatic series displaying a differentiation trend from cumulitic hornblendites to gabbros, gabbro-diorites, quartz-diorites, tonalites and leucogranites. Despite a relatively strong deformation, mingling features between mafic and intermediate to felsic facies are still visible, pointing to their (sub)contemporaneous emplacement. Zircons have been extracted and dated in situ with the U-Pb LA-ICPMS technique on the basis of cathodoluminescence imaging. A gabbro sample yielded a mean  $^{206}\text{Pb}/^{238}\text{U}$  age of  $292.8 \pm 2.0$  Ma (95% confidence level, based on 23 measurements), whereas a tonalite yielded an age of  $293.9 \pm 1.2$  Ma (35 measurements) and a leucogranite an age of  $288.7 \pm 3.4$  Ma (15 measurements). These three dates are almost overlapping within uncertainties and point to a magmatic event at ca. 292 Ma.

The mafic layers of the banded amphibolites intruded by the Alpigia magmatic complex display basaltic compositions with tholeiitic geochemical characteristics. The associated felsic layers consist of a quartz + plagioclase  $\pm$  amphibole  $\pm$  carbonates mineral assemblage. They are chemically very heterogeneous, ranging from 50 to 76 wt-%  $\text{SiO}_2$ , and display unusual concave-shaped REE chondrite-normalized patterns with low to very low MREE values, but positive Eu anomalies. Further investigations are needed to decipher the origin of these felsic layers and to establish if they are contemporaneous with the basaltic horizons or not. Zircons were extracted from two different felsic samples. Cathodoluminescence imaging revealed complex internal structures with a homogeneous whitish external envelope suggesting metamorphic recrystallization. As a matter of fact, measured dates spread over a large range from ca. 480 down to 160 Ma. Both samples yielded a consistent subset of data allowing calculation of mean  $^{206}\text{Pb}/^{238}\text{U}$  ages. The first sample yielded an age of  $476.3 \pm 5.2$  Ma and the second sample an age of  $464.5 \pm 4.1$  Ma. Although no field evidence has been found to establish the contemporaneity of the felsic and tholeiitic mafic layers, the latter are most probably no younger than Ordovician.

An augengneiss from the host rock of the Alpigia magmatic complex has also been dated. Gem-quality zircons yielded a mean  $^{206}\text{Pb}/^{238}\text{U}$  age of  $451.8 \pm 2.8$  Ma based on a coherent set of 19 measurements. Three inherited zircon cores gave ages of  $553.8 \pm 9.4$ ,  $507.8 \pm 7.6$  and  $492.4 \pm 8.5$ , respectively. This ca. 450 Ma magmatic age is typical of the so-called "older orthogneisses" found in most Alpine basement units.

The ca. 292 Ma age of the Alpigia calc-alkaline magmatism is very similar to that of the neighbouring Antigorio pluton, where Bergomi et al. (2007) dated a tonalite at  $296 \pm 2$  Ma, granodiorites at  $294 \pm 5$  and  $290 \pm 3$  Ma, and a granite at  $289 \pm 4$  Ma. Conversely, Bussien et al. (2011) obtained mean  $^{206}\text{Pb}/^{238}\text{U}$  ages of  $300 \pm 5$  Ma and  $302 \pm 8$  Ma for the Matorello granodiorite in the Sambuco unit and  $308 \pm 7$  Ma for the Cocco granodiorite in the Maggia unit. Thus, if the spatial distribution of late Variscan magmatic ages is used as a paleogeographic criterion, the Alpigia magmatic complex and its host rock should be linked to the Antigorio nappe rather than to the Sambuco-Maggia units, in line with the tectonic interpretations of Keller et al. (1980) and Steck et al. (2013).

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