Thirty-two years of geochronological work in the Central and Western Alps: A review on seven maps

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This paper represents a review of the last 32 years of geochronological work in the Central and Western Alps. Some of these data, distributed in over 240 papers, are poorly accessible, thus starting to fade away from the view of Alpine geologists. The data have been represented on 7 maps, 3 of which, at a scale of 1:800'000, cover the area from the Alpine/Apennine boundary near Genova, through to the western Silvretta. Map I contains Rb-Sr data, map II summarizes the K-Ar and Ar-Ar mineral data. Map III shows U-Pb and whole rock data, and therefore represents our knowledge of the pre-Alpine history. The ages on maps I and II are represented by a colour code, the symbol on the maps represents the mineral concerned. A number, printed near the symbol leads to the references, which are given both in numerical and alphabetical order. 4 maps of the Central Alps are at a scale of 1 :635 000, Maps IV and V give the fission track data for apatite and zircon respectively. On maps VI and VII, the K-Ar and Rb-Sr data are given respectively at the same scale for direct comparison. The interpretation of the mineral data is presented in the light of the cooling and blocking temperature concept, which is discussed in detail. All ages are calculated using the IUGS recommended constants.

The present compilation of joint geochronological research in the Central and Western Alps reveals surprising inhomogenieties both in regional and temporal distribution. The Western Alps contain practically no Rb-Sr and U-Pb data. A majority of the data deals with the Alpine metamorphism and with the cooling after the Alpine orogeny. From pre-Variscan times, only little can be said with certainty, no pre-Variscan mica ages having been found so far. Widespread Variscan granitoids (360-280 Ma) which become more acidic with time, intruded a pre-Variscan polymetamorphic basement of generally lower crustal origin, with maximum sedimentation ages between 1000 and 500 Ma. Around 300 Ma before present calcalkaline magmatism, both intrusive and effusive started, and lasted until mid-Permian, the onset of Verrucano sedimentation. These late Variscan magmatic phases mark the onset of continental thinning and rifting, with high heat flow and concomitant hydrothermalism along preferred lystric planes geochemically completely altering the adjacent rocks and thus lowering their radiometric ages. In the Austroalpine/Southalpine units, mica ages between 240 and 140 Ma mark the slow uplift and cooling of these zones, from lower to upper crustal conditions.

The Eoalpine orogeny has been subdivided into an early eclogitic stage (140-85 Ma) and a later blueschist and cooling stage (85-60 Ma). The coincidence of two or more different chronometers facilitates the interpretation of the Eoalpine age data.

The Tertiary has been subdivided into 4 phases, the ±30 Ma calcalkaline magmatism subdividing the Cenozoic era into the Mesoalpine and Neoalpine.

1) The period between 60 and 45 Ma is characterized by relative quiescence (Trumpy's 1961 restoration phase). Thesè ages can be interpreted in different ways. For example, as mixed pre-Alpine/Tertiary ages, mixed Eoalpine /Tertiary; or as ages from regions without a pronounced break in the P-T-conditions between the Eoalpine and Tertiary evolution.

2) The 45-30 Ma period marks the Mesoalpine metamorphic phase, found dominantly outside the area. therefore The term Lepontine phase (as used by the Bern group) for this age range implies a more local distribution and is thus inapropriate.

3) Ages between 30 and O Ma mark the Neoalpine event, subdivided (arbitrarily at 15 Ma - a more or less quiet period) into early and

4) Late Neoalpine.

The Alpine movements of major tectonic lines, such as the Insubric line, the Simplon line and the Aosta-Ranzola line, have been dated both during their ductile as well as their brittle movements, by means of mineral ages. Thus periods of polyphase Alpine movements, ranging from as early as Jurassic and lasting throughout the whole Tertiary have been identified. Also Jurassic, Cretaceous, and Miocene movements along major thrust planes of nappes have been dated with success, principally by the K-Ar and Ar-Ar methods on dynamically recrystallized K- white micas. Cooling curves for a great variety of different regions in the Central Alps have been established.