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DISCRIMINATING METAMORPHIC GRADE AND STRUCTURAL LEVEL IN FIRST-CYCLE MODERN SAND FROM WESTERN ALPS

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The present work focuses on modern first-cycle sand from low- to high-grade basement nappes of the thick-skinned Alpine Orogen, with the aim of describing the diagnostic signature of orogenic detritus and of devising the more suitable petrographic parameters allowing discrimination of metamorphic grade and structural level of source rocks.

Sources of Alpine crystalline detritus are varied and include: a) basement rocks of the European continental margin (Hercynian plutonic and metamorphic rocks of the External Massifs, metamorphic nappes of the Brianzonese Domain); b) distal continental margin to oceanic metamorphic units of the Ligurian-Piemontese Domain; c) basement nappes of the Adria continental margin (Sesia-Lanzo Zone, Dent-Blanche Klippe); d) Southalpine basement of the the Southern Alps thrust belt); e) Tertiary magmatic rocks of the Alpine cycle (Peri-Adriatic arc).

Sources are commonly intermingled, and detrital signatures are not univocal. Moreover, recycling of sedimentary cover and foreland basin units makes unraveling of primary sources a complicated task. For these reasons, we collected a large petrographic data set on all major alpine tributaries of the Po River draining the crystalline nappes of the Western Alps, from Liguria to Lombardy.

In order to obtain full quantitative information particularly on rock fragments, which provide essential information in orogenic sands, data were collected by means of a very detailed scheme including over 80 categories of grain-types, and according to both the Gazzi-Dickinson QFL and Indiana traditional QFR methods. A simple but complete synthesis of framework petrography is provided by an extended spectrum of nine compositional key indices: Q = quartz; F = feldspars and feldspathoids; Li = intrusive lithics (aplite, granophyre); Lv = volcanic and subvolcanic lithics; Lc = carbonate lithics, including marble grains which could not be consistently distinguished from recrystallized sparite; Lp = pelitic terrigenous lithics; Lch = chert and cherty mudrock lithics; Lm = metamorphic lithics; Lo = serpentinite and serpentine-schist lithics.

Further informations of source rocks are provide by heavy mineral with a spectrum of ten key indexes: ZTR = ultrastable minerals (zircon, tourmaline, rutile; HUBERT, 1962); T&O = titanium minerals and others (e.g. sphene, anatase, brookite, apatite, barite); Hb = horneblende; AA = other amphiboles; CPX = clinopyroxenes; OPX = orthopyroxenes; OS = olivine and spinel; LgM = low-grade metamorphic minerals (e.g. pistacite, clinozoisite, zoisite epidotes, chloritoid, pumpellyte); Gt = garnet; HgM = high-grade metamorphic minerals (e.g. staurolite, andalusite, kyanite, sillimanite).

In order to differentiate between structural level of different composition and metamorphic grade, a detailed classification of metamorphic lithics was designed. Metapelite, metafelsite, and metabasite grains were further subdivided into subspecies according to increasing degree of phyllosilicate crystallization, progressive development of foliation, and mineralogical parageneses. Among metapelite grains in particular, slate lithics with tiny sericite and weak rough cleavage (Lmp1), were distinguished from phyllite lithics with sericite lamellae and strong cleavage

(Lmp2), from schist lithics with micaceous lamellae and schistosity (Lmp3), micaschist lithics with muscovite flakes, well-developed schistosity and occasionally medium-high grade minerals (e.g., garnet) (Lmp4). This classification represents an extension of that originally proposed by DORSEY (1988).

References

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