LOOKING AT THE TIMING OF TRIASSIC MAGMATISM IN THE SOUTHERN ALPS

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Middle Triassic volcanics and volcanoclastics interbedded in sedimentary successions are well known from the Southern Alps and especially from the Dolomites region (e.g. Buchenstein Fm., Fernazza Fm.), where several studies have been portrayed in order to define petrographic patterns and timing of magmatic product emplacement (cf. Abbas et al., 2018; Storck et al., 2018 and references therein). However, the increasing amount of available information allows to better define the timing and distribution of the whole Triassic magmatism in the general framework of the Southern Alps, and adjacent plates composing the Western Tethys margin. Additionally, improvements in biostratigraphy, sequence stratigraphy and geochronology allowed to revise sedimentary successions in which the magmatic products are intercalated and to establish new correlations.

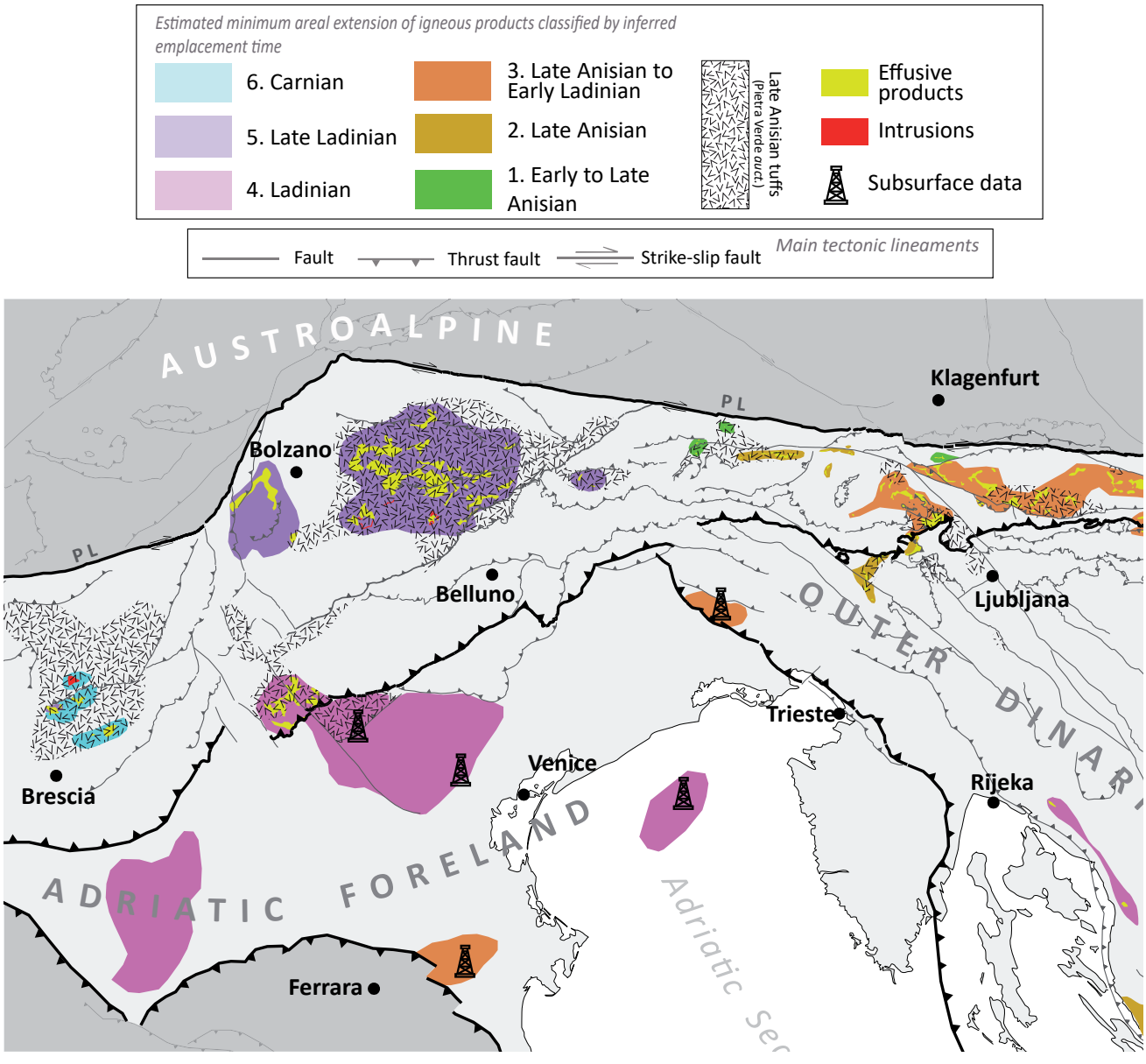

FIG. 1: Distribution of Triassic magmatic products throughout the Southern Alps, Adriatic Foreland and northern Outer Dinarides, classified by estimated time of emplacement. Modified from (Lustrino et al., in press).

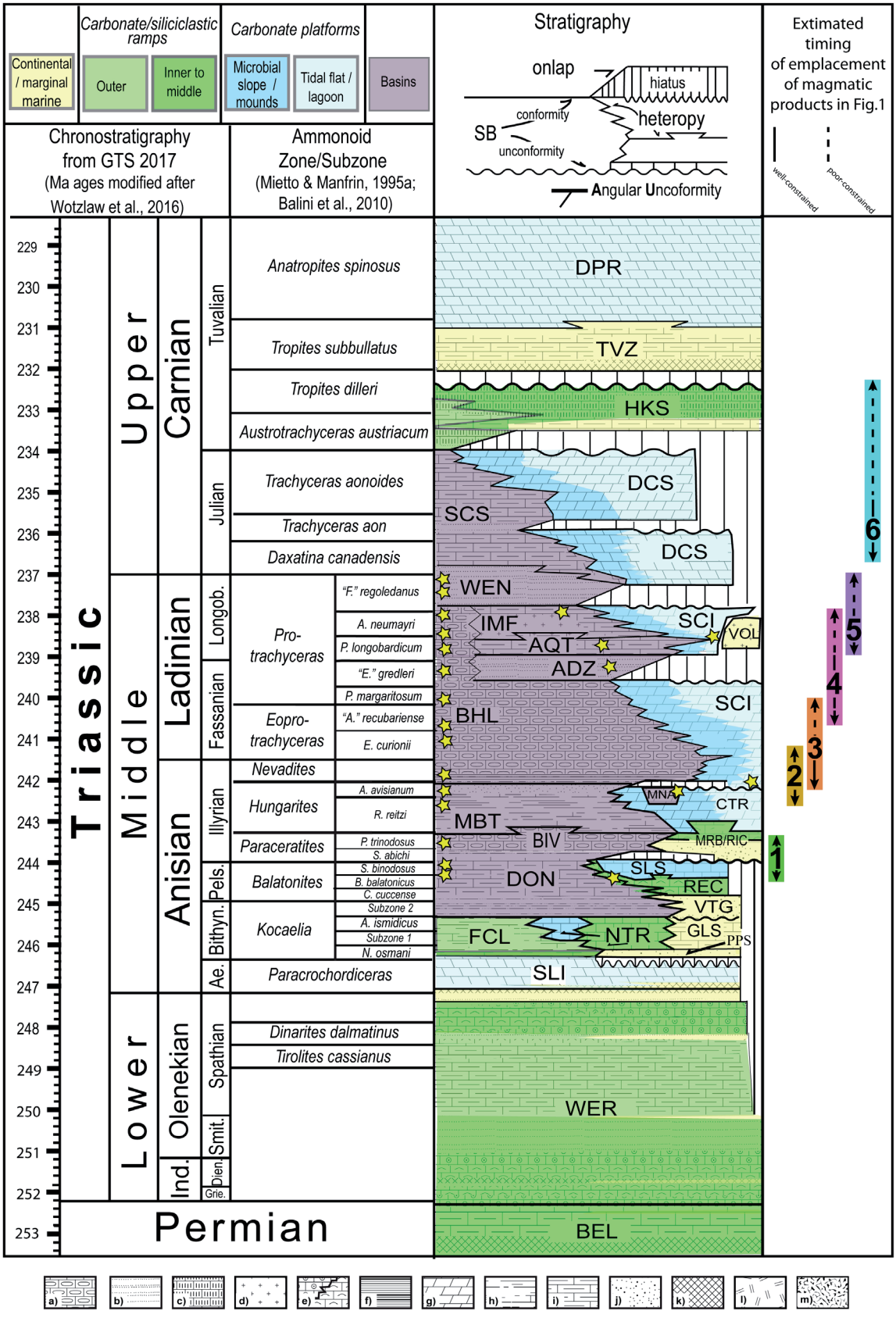

FIG. 1: Scheme showing the bio-chrono-stratigraphy of the Middle-Upper Triassic succession of the Dolomites: the occurrence of ash falls and tephras are marked by yellow stars. On the right column, the time-span of intrusive and effusive products displayed in Fig. 1 for the whole Southern Alps is shown. Lithostratigraphic abbreviations: BEL: Bellerophon Formation; WER: Werfen Formation; SLI: Lower Serla Dolomite; PPS: Piz da Peres Conglomerate; FCL: Coll'Alto dark Limestones; NTR: Monte Rite Formation; GLS: Gracilis Formation; VTG: Voltago Conglomerate; DON: Dont Formation; REC: Recoaro Limestone; SLS Upper Serla Dolomite/Formation; MRB/RIC: Richthofen Conglomerate and Morbiac dark Limestone; BIV: Bivera Formation; MBT: Ambata Formation; MNA: Moena Formation; CTR: Contrin Formation; BHL: Buchenstein Formation; SCI: Sciliar Formation; ADZ: Zoppè Sandstone; AQT: Aquatona Formation; IMF: Fernazza Volcanic Complex (Fernazza Formation); WEN: Wengen Formation; SCS: San Cassiano Formation; DCS: Cassian Dolomite; HKS: Heiligkreuz Formation; TVZ: Travenanzes Formation; DPR: Dolomia Principale. Lithologies: a) cherty limestone; b) sandstone; c) sandy limestone; d) volcanics and volcaniclastics; e) oolitic-bioclastic limestone; f) black platy limestone or dolostone, black shale; g) dolostone; h) marlstone, claystone and shale; i) marly limestone; j) conglomerate; k) evaporates; l) tuffs, pyroclastics; m) lava, pillow-lava, pillow breccia. Modified from (Abbas et al., 2018).

First clear evidences of volcanic deposits come from small outcrops in the Carnic Alps and Southern Karawanken (Buser, 1980; Obenholzner and Pfeiffer, 1991), where intermediate tuffs were emplaced both in subaerial and shallow marine environments during the late Pelsonian (early late Anisian). In other parts of the Southern Alps, few tufitic intercalations have been found in coeval basinal successions (e.g. Dont Fm. and Recoaro Lm.). During the Illyrian (late Anisian) magmatism expanded in a wider region and significant horizons of ignimbrites and other pyroclastics were emplaced in shallow environments from eastern Carnia to the Julian Alps (Lucchini et al., 1980; Gianolla, 1992; Celarc et al., 2013). Greenish tuffs rarely occurring in coeval basinal successions of the Southern Alps (e.g. Bivera Fm.) progressively increased, reaching significant thickness in the uppermost Anisian (Lower Pietra Verde, Ambata and Buchenstein fms cf. Viel, 1979; Brack and Muttoni, 2000) in the Southern Alps and nearby regions (e.g. External Dinarides; (Smirčić et al., 2018). At this time, intense acid magmatism involved also the eastern Julian Alps, Southern Karawanken and Kamnik-Savinja region, originating relatively thick porphyritic deposits (Dozet and Buser, 2009; Kralj and Celarc, 2002). In the Dolomites, pyroclastics and volcanogenic sedimentary deposits seems to be thicker and proximal in the southernmost areas and locally in the northern part (Cros and Houel, 1983).

From the latest Anisian to the Ladinian, magmatism (of acid to intermediate character) developed widely in the southern portion of the Southern Alps (Vicentinian Prealps cf, Barbieri et al., 1982; De Vecchi and Sedea, 1983) and in the Adriatic Foreland (ENI subsurface data), as well as in Outer Dinarides (northern Dalmatia e.g., Lugović and Majer, 1983), locally giving raise to thick successions of (mainly massive) porphyrites. Trachybasalts and andesites occurring in the Brescia Prealps have been dated to the Ladinian as well (Cassinis et al., 2008).

A strong tectono-magmatic phase affected the Dolomite region during the late Ladinian, leading to large fault-scarp collapses, effusions of huge amounts of mafic volcanics in the basins (Viel, 1979) and to the emplacement of almost three main intrusions, related to as many magmatic chambers (cf. Abbas et al., 2018 and references therein). Subaerial, basaltic lava bodies overlapped shallow carbonate successions also in the region westward to the Adige valley (Avanzini et al., 2007; 2013). The parossistic mafic phase is recorded by the Fernazza Fm. and is mainly confined in a very short time between Longobardicum and Regoledanus Subzones (Fig. 2), anyway, some effusive products and few pyroclastic levels are documented also in the mainly post-volcanic Wengen Fm (Bosellini et al., 1977; Storck et al., 2018).

Evidences of magmatism in the Early Carnian are limited to the central part of Southern Alps, where porphyrites and lavas were emplaced subaerially or in subvolcanic bodies (Cassinis et al., 2008).

Even if the geochemical variation of igneous products in space and time doesn't show a clear trend, the younging direction of Triassic magmatism in the whole Southern Alps seems to follow a roughly NE-SW direction, and this should be considered when geodynamic settings are proposed to explain the development of magmatism in the Dolomites region and in the Southern Alps.

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