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Permian sporomorphs from upper Palaeozoic succession of Southern Tuscany (Italy): new constraints for the stratigraphy and palaeogeographic setting of the Tuscan Domain

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Recent biostratigraphic and sedimentological studies in the inner Northern Apennines (Italy) permit to refine the upper Palaeozoic successions of southern Tuscany, allowing new hypothesis to frame these formations in the palaeogeographic scenario inherited by the Variscan orogenesis. The Tuscan pre-Triassic successions, now exposed in the Monticiano-Roccastrada Unit, are generally barren or scarce in term of biomineralized fossiliferous content. They were mostly affected by HP-LT to LP-HT metamorphism that, together with their limited exposures, made difficult the stratigraphic correlations. This presentation is focused on three units (i.e. Falsacqua, Torrente Mersino and Carpineta formations) which age attribution and correlation were strongly debated. The Falsacqua Formation is mainly characterized by black to dark-grey phyllite, metasiltstone and metasandstone with dark metacarbonate intercalation. Due to the lack of biomineralized fossil content, by lithostratigraphic correlation with other Tuscan successions, this formation was referred to late Carboniferous-early Permian or Devonian. The Torrente Mersino Formation mainly consists of black to dark-grey quartz-phyllite, quartz metaconglomerate, light-grey quartzite, green phyllite and quartzite and light-grey phyllite. This formation is barren of fossil content and has been alternately assigned to Ordovician-Silurian, Silurian-Devonian, late Carboniferous-Permian and Triassic by lithostratigraphic correlation with other Tuscan and Sardinian successions. The Carpineta Formation is characterized by graphite-rich mudstones with carbonate-siltitic nodules. This unit was referred to the upper Visean-Serpukhovian based on its palaeontological content within the carbonate nodules. The first finding of a well-preserved microflora of middle Permian age in the Falsacqua and Torrente Mersino formations and of middle-late Permian age in the Carpineta Formation adds more constrains to the age attribution. This new age assignment permits to correlate the investigated Falsacqua and Torrente Mersino formations with the coeval ones belonging to southern Tuscany (i.e. Farma and Poggio al Carpino formations) and Elba Island (Rio Marina Formation) characterized by a similar microfloral content and to support a younger deposition of the Carpineta Formation than the Farma Formation one.

Moreover, the occurrence of Gondwana-related sporomorphs in all the considered formations proposes a new palaeogeographic scenario for the northern Gondwana margin. Specifically, the present integrated study suggests that the northern margin of Gondwana fragmented through a series of transtensional phases. In this framework, the investigated upper Palaeozoic formations recorded marine siliciclastic sedimentation within either coeval pull-apart basins or laterally related facies of the same basin.