The Geological Map of Sannio and Surrounding Areas by Raimondo Selli (Scale 1:100,000). A precious collection of still current data

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ABSTRACT

In 1962, on the occasion of the congress of the Italian Geological Society on the theme of «The geology of the Apennines» (Rome, 13-14 December 1962), Raimondo Selli presented a work entitled «The tectonic problem of the Southern Apennines» in which the stratigraphic and structural lineaments of a wide and complex area stretching from Southern Abruzzi to Northern Calabria were illustrated in detail. This work was never published and the reason is unknown. At about twenty years from the death of Raimondo Selli a typewritten text of this work, which should have been published in 1964 in the Volume 4 of the Memoirs of the Italian Geological Society, has been discovered. Together with the manuscript, an unpublished geological map at a scale of 1:100,000 entitled «Geological Map of Sannio and Surrounding Areas» was recovered. This map covers a wide area of the Southern Apennines from Southern Abruzzi to Irpinia. We do not know exactly the date of compilation, but from the legend we can suppose a date surely before 1962.

Abitize to the plina. We do not know exactly the date of compliantial, but from the legend we can suppose a date surely before 1962. In the unpublished paper «The tectonic problem of the Southern Apennines» Selli modified quite significantly the ideas expressed in the oral presentation of 1962 and in the previous publications on the geology of the Southern Italy (SELLI, 1957, 1962), but there is no trace of this revision in the legend of the «Geological Map of Sannio and Surrounding Areas». Therefore, we have considered it appropriate to make some brief comments on the content of the unpublished work with the aim of enabling a reading of the geological map that respects the ideas arrived at by its author in 1964. A reading of the map without knowing the content of the unpublished paper, in fact, would not enable the reader, even though expert in the geology of Southern Italy, to fully appreciate its value and above all would not do justice to Raimondo Selli's capacity to recognize and acknowledge geological evidence in conflict with ideas expressed in its previous publications.

On superficial analysis the Geological Map of Sannio and Surrounding Areas could be considered as a document of purely historical value, given that the legend reflects a scheme already surpassed by the same Selli in 1964. In reality, this map is far from obsolete because it is an objective restitution of the geology of the study area not at all influenced by any pre-existing model. The geological map of Selli is therefore an unexplored mine of data still to be fully exploited containing observations that are well worth recovering and studying in the case we wish to realize an efficient update of the geological cartography of the region. Products such as this are increasingly rare today because too often do we see geological maps that derive from models instead of contributing to create them.

KEY WORDS: Raimondo Selli, geological mapping, Molise nappe, Sannio nappes, Southern Apennines.

RIASSUNTO

La carta geologica del Sannio e delle aree circostanti di Raimondo Selli (Scala 1:100.000). Una preziosa collezione di dati ancora attuali.

Nel dicembre 1962, in occasione del Convegno Sociale della Società Geologica Italiana sul tema «La geologia dell'Appennino» (Roma, 13-14 Dicembre 1962), Raimondo Selli presentò una relazione dal titolo «Il problema tettonico dell'Appennino meridionale». In questa relazione l'Autore illustrò in maniera circostanziata, attraverso sezioni colonnari, profili geologici e schemi illustrativi di vario tipo, i lineamenti stratigrafici e strutturali di un'area vasta e complessa estesa dall'Abruzzo meridionale alla Calabria settentrionale. Questo lavoro non fu mai pubblicato e non se ne conoscono i motivi. A circa venti anni dalla morte di Raimondo Selli è stato tuttavia ritrovato un testo dattiloscritto della relazione presentata nel dicembre 1962 che, da una nota originale dell'Autore, avrebbe dovuto essere pubblicato nel 1964 nel Volume 4 delle Memorie della Società Geologica Italiana. Assieme a questo dattiloscritto è stata trovata una carta geologica inedita alla scala 1:100.000 intitolata «Carta geologica del Sannio e regioni limitrofe» della quale non si conosce con esattezza la data di compilazione. Questa carta copre una vasta area dell'Appennino meridionale compresa tra la zona di confine tra l'Abruzzo e il Molise e la zona di confine tra l'Irpinia e il Salernitano. Dalla terminologia usata in legenda possiamo dedurre una data di stesura sicuramente precedente il 1962 perché alcuni dei nomi formazionali che compaiono in carta, utilizzati anche nei logs di pozzi perforati nei primi anni 60, vengono in seguito da Selli abbandonati e sostituiti da altri nomi, come si evince dalla lettura del lavoro sul Paleogene del 1962 e del lavoro inedito del 1964.

Nel dattiloscritto «Il problema tettonico dell'Appennino meridionale» Selli modifica in maniera non trascurabile le idee espresse nella relazione orale del 62 e nelle precedenti pubblicazioni sulla geologia dell'Italia meridionale (SELLI, 1957, 1962), ma di queste modifiche non c'è traccia nella legenda della «Carta geologica del Sannio e regioni limitrofe». Abbiamo ritenuto pertanto opportuno riassumere brevemente i contenuti del lavoro inedito, al fine di permettere una lettura della carta geologica del Sannio rispettosa delle idee raggiunte dal suo autore nel 1964. Una lettura di questa carta senza conoscere i contenuti del lavoro inedito, infatti, non avrebbe consentito al lettore, ancorché esperto sulla geologia dell'area, di apprezzare pienamente il suo valore e soprattutto non avrebbe reso giustizia alla capacità di Raimondo Selli di saper recepire evidenze geologiche che entravano in conflitto con idee espresse nelle sue precedenti pubblicazioni.

Ad un'analisi superficiale, la Carta geologica del Sannio e regioni limitrofe potrebbe essere considerata come un documento di valore puramente storico, tanto più considerando il fatto che la legenda ripropone uno schema superato dallo stesso Selli nel 1964. In realtà, questa carta è tutt'altro che obsoleta perché è una restituzione obiettiva della geologia dell'area indagata, al di là del modello interpretativo proposto. La carta geologica di Selli è quindi una miniera non esplorata e non sfruttata di dati e osservazioni che andrebbero oggi con tutta umiltà studiati e recuperati ove si volesse procedere ad un reale aggiornamento della cartografia geologica dell'area. Prodotti di questo tipo sono al giorno d'oggi piuttosto rari perché sempre più spesso vengono sostituiti da carte geologiche che derivano da modelli interpretativi anziché contribuire a costruirli.

TERMINI CHIAVE: Raimondo Selli, cartografia geologica, coltre molisana, coltri sannitiche, Appennino Meridionale.

1962 saw the publication of Volume 3 of the Memoirs of the Italian Geological Society in which there was a paper by Raimondo Selli entitled «Il Paleogene nel quadro della geologia dell'Italia Meridionale» (The Paleo-

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Fig. 1 - Geological scheme of Southern Italy according to SELLI 1962, slightly simplified from the original picture. – Schema geologico dell'Italia meridionale secondo SELLI, 1962, leggermente semplificato rispetto alla versione originale.

gene in the context of the geology of Southern Italy). In this work, which is a cornerstone in the history of the geology of Southern Italy, Selli presented in a complete form his model of the structure and tectonic evolution of the Apennines between the regions of Abruzzi and Calabria. Figs. 1 and 2 show the geological scheme of Southern Italy according to SELLI (1962), slightly simplified with respect to the original version, with the geometric relations between the various units and the ages of the nappe transport. Fig. 3 is an auxiliary index map with the principal toponyms mentioned in the following pages.

In December of the same year, on the occasion of the congress of the Italian Geological Society on the theme of «The geology of the Apennines» (Rome, 13-14 December 1962), Selli presented a work entitled «Il problema tetton-

ico dell'Appennino Meridionale» (The tectonic problem of the Southern Apennines). In this presentation the Author illustrated in detail the stratigraphic and structural lineaments of a wide and complex area stretching from Southern Abruzzi to Northern Calabria by means of columnar sections, geological profiles and sketches of various types. The model presented in December 1962 was not dissimilar to schemes in previous publications on the regional geology of Southern Italy (SELLI, 1957, 1962). However, in this presentation there was the first complete documentation of the whole database on which the model was based.

The paper «The tectonic problem of the Southern Apennines» was never published and the reason is unknown. At about twenty years from the death of Rai-





– Relazioni geometriche delle unità tettoniche e stratigrafiche dell'Appennino Meridionale ed età di trasporto delle coltri secondo SELLI, 1962. I colori delle unità geologiche sono quelli adottati in fig. 1.

mondo Selli, however, a typewritten copy of this paper has been discovered. According to an original annotation of the Author the paper should have been published towards the end of 1964, date foreseen for the closure of Volume 4 of the Memoirs of the Italian Geological Society, accompanied by a geological scheme of the entire study area.

Together with the typewritten text of the unpublished paper, a draft and the final version of a geological map at a scale of 1:100,000 were also recovered. This unpublished map, entitled «Geological Map of Sannio and Surrounding Areas» (for simplicity's sake *«geological map of Sannio»*), covers a wide area of the Southern Apennines from Southern Abruzzi to Irpinia. We do not know exactly the date of compilation of the map, but from the legend (see figs. 4 and 5) we can suppose a date surely before 1962. This is because the terminology used in the map, also used in the basic stratigraphy of commercial boreholes drilled in the early sixties, was partly abandoned by Selli in the paper on the Paleogene of 1962 and in the unpublished paper of 1964 where some names have been substituted with others. The geological map of Sannio covers the northern portion of the Southern Apennines and so far no cartographic document has been found that refers to the rest of the area investigated by Selli that extends from Irpinia to Northern Calabria. However, we do presume that a detailed geological map of this area must have existed because the regional schemes published by Selli in 1957 and 1962 (e.g. see fig. 1) had to be certainly based on original surveys. We



Fig. 3 - Index map with the principal toponyms cited in the text. – *Carta indice dei principali toponimi indicati nel testo.*

should not forget, in fact, that the current Sheets of the Southern Apennines belonging to the 1:100.000 scale Geological Map of Italy were all published after 1964. The fair copy of the geological map of Sannio was likely compiled by Selli for the oil company «Società Idrocarburi Ariano-Gruppo Montecatini», which operated in the late fifties-early sixties in the Sannio-Molise region and to which Selli was a consulting geologist (see also Crescenti in this volume). The first draft of the map, surely used by the Author as a working map in the field, shows traces of numerous successive upgrades. The reading of this document, which we shall refer to as *«field map»*, is even more exciting than that of the fair copy. In its cancellations and colour adjustments, in the roughly defined unit boundaries, in the irregular colour shadings referring to out-

crops only expeditiously surveyed and in the dips of the strata often approximately marked, it still conserves clear traces of the process of knowledge acquisition of the Author, with all those uncertainties and afterthoughts that normally accompany regional geological researches. A fine example is given in fig. 6, which is a detail of the field map that refers to the High Volturno region between the eastern margin of the Mainarde Mountains and the western edge of the Frosolone structure. The Author recognised in this area Cretaceous platform limestones (shadowed olive green west and south of Castel San Vincenzo) and Miocene basinal limestones referred to the Montagnola Formation (red), both belonging to the paleoautochthonous substratum. In the same area, the variegated shales (violet) of the Serraparco Formation refer-



Fig. 4 - Detail of the legend of the geological map of Sannio (fair copy). – Dettaglio della legenda della carta geologica del Sannio (bella copia).



Fig. 5 - Detail of the legend of the geological map of Sannio (fair copy). – Dettaglio della legenda della carta geologica del Sannio (bella copia).

able to the Molise nappe (Nappe I, Serraparco) have also been mapped (see, e.g., upper right side of fig. 6). West of Castel San Vincenzo and between Cerro al Volturno and Forlì del Sannio, silicoclastic basinal deposits on top of the Cretaceous limestones, identified by ochre colour with burnt brown vertical lines, have been distinguished from the turbidite deposits of the Agnone Formation cropping out just north of the area. These observations have not been reported in the fair copy of the geological map of Sannio perhaps because they were considered too preliminary by Selli, or because this survey post-dates the compilation of the fair copy. In any case, it is worth underlining the fact that already before 1964 Selli had recognised in the High Molise region a sedimentary unit (later termed Castelnuovo al Volturno Flysch by PATACCA *et alii*, 1990 from the name of a village located about 8



Fig. 6 - Expeditious geological survey of the area between the eastern margin of the Mainarde Mountains and the western margin of the Frosolone structure. After the Sannio field map of Selli. Scale 1:100,000. *– Rilevamento geologico speditivo dell'area compresa tra il margine orientale dei monti delle Mainarde e il margine occidentale della struttura di Frosolone. Da: carta di campagna di Selli. Scala 1:100,000. Dai tipi dell'Istituto Geografico Militare. Autorizzazione n. 5805 in data 14-10-2003.*

kilometres NW of Colli al Volturno) lithologically different from the nearby Agnone Fm. There is no trace of the existence of these silicoclastic turbidites in the official Geological Map of Italy, Sheets 153 Agnone and 161 Isernia (SERVIZIO GEOLOGICO D'ITALIA, 1971a,b), where an undifferentiated Upper Miocene sandy unit has been mapped over the whole area. Fig. 7 shows a totally different case from that of fig. 6 because it refers to an area (Sannio Mountains and eastern margin of Matese) deeply investigated by Selli probably already before the publication of the work dedicated to the Miocene of Southern Italy (SELLI, 1957). As can be seen in the figure, the contacts between the mapped units, as well as the various tectonic symbols, appear to have been traced with great detail and precision both in the field map (fig. 7a) and in the fair copy (fig. 7b), without there being any difference between the two documents. The accuracy of the field map in this area suggests that this document was a preliminary fair copy successively turned into a field map and that the Sannio region was the first area extensively investigated by Selli, as also indicated by the numerous studied stratigraphic sections (dark blue segments sided by Arabian numbers). Both in the fair copy and in the field copy, the lower tectonic unit (west of the heavy dashed-and-dotted red line in fig. 7a and of the heavy dotted red line in fig. 7b) is the paleoautochthonous substratum here represented by upper Triassic-Cretaceous carbonates of the Faicchio Formation (grey), Camposauro Formation (light blue) and Vitulano Formation (grass green) upwards followed by the Langhian-lower Helvetian Cusano Formation (burnt brown diagonal lines), the lower-middle Helvetian Longano Formation (terracotta) and the upper Helvetian-Tortonian Pietraroja Formation (ochre). Towards the east, these deposits are tectonically overlain by various terms of the Sannio Nappes (Nappe II), here represented by the basinal deposits of the Santa Croce Formation (the pale purple and crimson red colours indicate different lithofacies within the same formation) and by the terrigenous deposits of the overlying Molinara Formation (golden brown), the latter corresponding to the well-known San Giorgio Formation in SELLI (1962). Local chaotic combinations of lithotypes referable to the above formations have been marked with variously coloured diagonal lines (see legend in fig. 4).

In a footnote of the introduction of the unpublished paper «The tectonic problem of the Southern Apennines» Selli states: «The current work presented in 1962 at the congress on the geology of the Apennines has undergone some modifications taking into account my successive research and papers published up until the whole of 1964, date of publication of the present issue of the Memoirs of the Italian Geological Society». In effect, in this manuscript Selli modifies quite significantly the ideas expressed in the oral account of 1962 and in the previous publica-



Fig. 7 - Small detail of the geological map of Sannio in the Matese-Sannio region. 7a field map; 7b fair copy. The dark blue segments sided by large Arabian numbers are the traces of studied stratigraphic sections. Red dots indicate solid hydrocarbon shows. The heavy dotted red line in the fair copy (heavy dashed-and-dotted red line in the field map) separates the autochthonous substratum (left side) from the Sannio Nappe (right side). – Dettaglio della carta geologica del Sannio nella regione del Matese-Sannio. 7a carta di campagna; 7b bella copia. I segmenti blu scuro affiancati da numeri rappresentano la traccia delle sezioni stratigrafiche studiate. I punti rossi indicano presenza di idrocarburi solidi. Le linee rosse punteggiate grosse nella bella copia (linee rosse grosse tratteggiate e punteggiate nella copia di campagna) separano il substrato autoctono (lato sinistro) dalla coltre del Sannio (lato destro). Dai tipi dell'Istituto Geografico Militare. Autorizzazione n. 5805 in data 14-10-2003.

tions on the geology of the Southern Italy, but there is no trace of this revision in the legend of the «Geological Map of Sannio and Surrounding Areas». Therefore, we consider it appropriate to reflect on the content of the unpublished work with the aim of enabling a reading of the geological map that respects the ideas arrived at by its author in 1964. A reading of the map without knowing the content of the unpublished paper, in fact, would not enable the reader, even though expert in the geology of Southern Italy, to fully appreciate its value, and above all it would not do justice to Raimondo Selli's capacity to recognize and acknowledge geological evidence in conflict with ideas expressed in his previous publications.

In its advanced, but not yet definitive version, the unpublished paper «The tectonic problem of the Southern Apennines» is divided into five chapters whose content is summarized in the following paragraphs.

Chapter 1. Introduction. Some problems of terminology are discussed and clarified (e.g. the meaning of the terms autochthony, allochthony, etc.), the first-order structural elements of Southern Italy are formally defined (Tyrrhenian hinterland, Apennine carbonate chain, Miocene foredeep, Plio-Pleistocene foredeep and foreland) and a summary is given of previous structural interpretations present in the geological literature.

Chapter 2. Stratigraphic elements. There is a concise description of the stratigraphic lineaments of the major structural units.

Chapter 3. Tectonic elements. The main regional structures are described and the principal tectonic problems are discussed, including the allochthony of the chaotic variegated shales with the enclosed rigid blocks and slides, the tectonic superposition of the carbonate units on the Lagonegro ones and the significance of the major South-Apenninic faults developed at a regional scale.

Chapter 4. Interpretation of structural problems. The problems dealt with in this chapter regard the provenance of the nappes and the meaning of the Apennine foredeep and carbonate chain.

Chapter 5. Attempt at geotectonic interpretation. In this chapter Raimondo Selli faces the mechanical problem of the gravity-driven orogenic nappe transport. The Author discusses the relations between surface deformations and deep dynamic processes that determine these phenomena and finally proposes a new scheme of the tectonic evolution of the Southern Apennines based on the model of a geosyncline system migrating in time from SW towards NE.

It is not our intention to delve into the specific details of the various chapters. We do, however, wish to point out some important differences compared with the schemes proposed by Selli in his previous works. In the unpublished paper, in fact, the Author reconsiders in a new light several geological problems, regarded as already solved in previous works, taking into account the results of biostratigraphic investigations carried out in the meantime by researchers of the Naples and Rome universities and of the Italian Geological Survey. These differences, explicitly discussed in the manuscript, do not appear in the unpublished map of Sannio either because the map legend, as already mentioned, pre-dates 1962 or because they refer to areas of the Southern Apennines not included in the map.

The differences between the 1964 unpublished paper and the preceding works of Selli concern both stratigraphic and structural aspects of the geology of the Southern Apennines. One of the main differences, referring to the stratigraphy of the paleoautochthonous carbonates, is the acknowledgement of the presence of Mesozoic-Tertiary basinal deposits in Northern Matese and in the nearby Frosolone zone, in the Maddalena Mountains and at Monte Foraporta near Lagonegro. The existence of these basinal deposits highlights a paleogeography notably more complex than that previously recognized by Selli when the Author maintained that during the Mesozoic an undissected shallow-water platform extended from the Tyrrhenian margin of the Apennines to the Apulia foreland. In the Molise-Sannio region, in particular, Selli recognises for the first time the existence of an autochthonous «Molise basinal sequence» the lower portion of which would reach the middle Cretaceous in surface sections and the upper Jurassic in the subsurface (Santa Croce 1 well, where Jurassic-Cretaceous basinal deposits, known under the informal names «Vitulano-Camposauro-Formation Equivalent», have been discovered below a Paleogene «Serraparco-Formation Equivalent», see CRESCENTI in this volume). A second major difference concerning the stratigraphic lineaments of the region regards the age of the Santa Croce Formation (Nappe II, in the geological map of Sannio) that in the past had been attributed to the Miocene and in the unpublished paper is attributed, although with some uncertainty, to the middle Cretaceous-middle Miocene, with consequent notable implications for the palinspastic relocation of the original sedimentary basin. As regards the structural architecture of the Southern Apennines, the main difference with respect to the previous works is the acknowledgement of important thrusts, described in the geological literature of that time, between the Mesozoic-Tertiary carbonates of the paleoautochthonous chain and the underlying Lagonegro units (tectonic windows of the Picentini Mountains, tectonic window of Padula and eastern border of the carbonate chain between Vietri di Potenza and Castelluccio), as well as within the carbonate massifs (e.g. thrust of Valle Rotonda between Atina and Colli al Volturno). In a new formulation of the tectonic evolution of the Southern Apennines, Selli explains the tectonic position of the carbonate units on top of the Lagonegro units by means of an initial transport of the Lagonegro Nappe on the Apennine paleoautochthonous carbonates and a successive thrust of the latter on the Lagonegro deposits due to the development of a shear zone cutting across the already structured system. Similar breaching mechanisms were suggested in the second half of the 1960s and, more recently, in the nineties by other researchers who probably followed the same line of thought as Selli between 1962 and 1964.

After this brief summary of the unpublished paper «The tectonic problem of the Southern Apennines», it will now be easier for the reader to fully understand the meaning of the single units in the geological map of Sannio in the light of the new ideas matured by its author between 1962 and 1964. In our comments we shall follow from bottom to top the order of the units described in the legend (see figs. 4 and 5). Reading of the legend may be helped by table 1, which shows the correspondences between the units distinguished in the «Geological Map of Sannio and Surrounding Areas» and the units subsequently described by SELLI (1962, 1964) in the same region. Table 1 also illustrates the correspondences between the units of Selli and those reported in the current geological literature, the geometric arrangement of which is schematically shown in fig. 8.



Fig. 8 - Structural architecture and geometric array, according to the current geological literature, of the tectonic and stratigraphic units mapped by R. Selli in the «Carta Geologica del Sannio e Regioni Limitrofe».

– Assetto strutturale e disposizione geometrica, secondo la moderna letteratura geologica, delle unità tettoniche e strutturali cartografate da R. Selli nella «Carta Geologica del Sannio e Regioni Limitrofe».

A) Formations of the Mesozoic paleoautochthonous substratum

This group includes (see fig. 5) the platform carbonates cropping out in the Apennines between the Matese area and the Picentini Mountains, from the middle Triassic Giffoni Formation to the upper Cretaceous Vitulano Formation. It is worth pointing out that the middle Triassic Giffoni Formation includes the oldest terms of the platform carbonates (Carnian black shales), as well as the basinal Lagonegro deposits cropping out in the Monti Picentini tectonic windows. It is clear that the updated information relative to the tectonic relations between carbonate massifs and Lagonegro units, described in the unpublished work, has not been added in the geological map of Sannio. Finally, Selli identifies with the name of Falasca Formation (from Punta Falasca in the Matese Mountains), the well-known «Calcari Pseudosaccaroidi» Auct., represented by Campanian-Maastrichtian basinal limestones disconformably overlying upper Triassic to upper Cretaceous shallow-water carbonates.

B) Nappe I (Serraparco)

The Nappe I, corresponding to the Molise Nappe of SELLI (1962), is merely represented by the Serraparco Formation («Argille Varicolori» *p.p. Auct.*). This formation consists of variegated shales doubtfully attributed to the Oligocene.

C) Tertiary autochthonous substratum (Sannio region) and mesoparautochthonous or allochthonous formations (Molise and Daunia regions)

The Tertiary autochthonous formations include the basinal deposits of the Montagnola Formation (Langhian),

the shallow to deeper-shelf carbonates of the Cusano and Longano formations (Langhian-lower Helvetian and lower-middle Helvetian respectively) and the overlying fine-grained silicoclastic turbidites of the Pietraroja Formation (upper Helvetian-Tortonian). Along the northern edge of Matese and along the south-eastern flank of la Montagnola di Frosolone, the Pietraroja Formation grades upwards into the coarse-grained sandstones of the Sant'Elena Formation (Tortonian).

The Tertiary mesoparautochthonous or allochthonous units, widespread in the Molise and Daunia regions, are represented by the upper Langhian-lower Helvetian bioclastic basinal carbonates of the Montefreddo Formation and by the upper Helvetian-Tortonian fine-grained siliciclastic flysch deposits of the Treste Formation, both unconformably overlying the allochthonous variegated shales of the Serraparco Formation. According to Selli, the Montefreddo Formation grades laterally into the Montagnola and Longano formations; the Treste Formation is considered a lateral equivalent of the Pietraroja and Sant'Elena formations (see fig. 5). The Montefreddo and Treste formations, corresponding to the Tufillo-Agnone mesoautochthon in SELLI (1962), were affected by orogenic transport during Tortonian, Messinian and early Pliocene times together with the Serraparco shales.

In conclusion, as far as the group of units C) is concerned, the legend of the map does not show substantial differences from the scheme of SELLI (1962) but the knowledge of the new elements contained in the unpublished work of 1964 allows a different reading of the map. In particular, the areal extent of the Cretaceous-Miocene Montagnola Formation (Miocene in the geological map of Sannio) may be considered the first picture of the regional distribution of the «Molise basinal sequence». In the official geological map of Italy at the scale 1:100,000 such a picture was available only several years later, after



Fig. 9 - Detail of the geologic map of Sannio (fair copy) showing a lateral facies transition between the Montagnola Formation (carmine red) and the Montefreddo Formation (dark brown) in the Southern Abruzzi-Alto Molise region north of Agnone. Scale 1:100,000. – Dettaglio della carta geologica del Sannio (bella copia) che mostra la transizione laterale di facies tra la Formazione Montagnola (rosso carminio) e la Formazione Montefreddo (marrone scuro) nella regione degli Abruzzi meridionali-Alto Molise a nord di Agnone. Scala 1:100.000. Dai tipi dell'Istituto Geografico Militare. Autorizzazione n. 5805 in data 14-10-2003.



Fig. 10 - Contact between the Nappe II and the Nappe I in the Trigno Valley near Trivento: heavy dotted red line in the field map (fig. 10a); heavy dashed-and-dotted red line in the fair copy (fig. 10b). Scale 1:100,000. – Contatto fra la Coltre II e la Coltre I nella valle del Trigno presso Trivento: linea rossa punteggiata grossa nella copia di campagna (fig. 10a); linea tratteggiata e punteggiata rossa nella bella copia (fig. 10b). Scala 1:100.000. Dai tipi dell'Istituto Geografico Militare. Autorizzazione n. 5805 in data 14-10-2003.

the publication of the Sheets 153 Agnone and 161 Isernia (SERVIZIO GEOLOGICO D'ITALIA (1971a,b).

A reading of the geological map of Sannio in the light of the stratigraphic and structural framework outlined in the unpublished paper could reveal some apparent inconsistencies in the regional scheme. In the northernmost part of the Molise region (see fig. 9), for instance, deposits unquestionably referable to the Montagnola (carmine red) and Montefreddo formations (dark brown) have been mapped together with two other sedimentary units characterised by intermediate lithofacies between the typical Montagnola Formation and the typical Montefreddo Formation (carmine red colour with brown diagonal lines and dark brown colour with red diagonal lines respectively, see legend in fig. 5). A gradual lateral transition of facies between lithostratigraphic units of different ages (Cretaceous-Miocene Montagnola Formation and Miocene Montefreddo Formation, i.e. Miocene Tufillo Formation in the unpublished paper) may appear as a stratigraphic inconsistency. However, this contradiction is only apparent if we consider that the lateral transition concerns only the Miocene terms of the Montagnola sequence, which form the bulk of the outcrops in this area.

D) Nappe II (Lame)

The Nappe II (also named Lame in the legend of fig. 5) corresponds to the Sannio Nappes of SELLI (1962). It is made up of variegated shales («Argille Varicolori» p.p. Auct.), doubtfully attributed to the Oligocene (Lame Formation), upward followed by lower Miocene basinal carbonates (Santa Croce Formation). The latter, in turn, are stratigraphically covered by lower-middle Miocene silicoclastic deposits (Molinara Formation, equivalent to the San Giorgio Formation in SELLI, 1962). Within the Lame, Santa Croce and Molinara formations, various lithosomes have been distinguished by Selli on the base of the prevailing lithology. Their names have derived from small villages and minor localities of the Sannio and Irpinia regions. Finally, chaotic associations of lithotypes referable to the Lame, Santa Croce and Molinara formations have been also mapped, combining the colour of the prevailing rock unit with variously coloured diagonal lines indicative of the subordinate lithostratigraphic units. As for the Nappe I, the terminology of the lithostratigraphic units is quite different from that used in SELLI (1962). The knowledge of these terms, extensively used in oil exploration in the beginning of the sixties, enable us to



Fig. 11 - Contact between the Nappe II and the Nappe I in the Volturara Appula area: heavy dotted red line in the field map (fig. 11a); heavy dashed-and-dotted red line in the fair copy (fig. 11b). Scale 1:100,000. – Contatto fra la Coltre II e la Coltre I nell'area Volturara Appula: linea rossa punteggiata grossa nella copia di campagna (fig. 11a); linea tratteggiata e punteggiata rossa nella bella copia (fig. 11b). Scala 1:100.000. Dai tipi dell'Istituto Geografico Militare. Autorizzazione n. 5805 in data 14-10-2003.

better understand the meaning of the stratigraphic units crossed by wells drilled in the Sannio and Molise regions at that time. Otherwise, no other new aspects emerge from the legend of the geological map of Sannio with respect to SELLI (1962). Yet again, however, the text of the unpublished paper still reserves surprises. The Santa Croce Formation is attributed to the Cretaceous-Miocene and no longer only to the Miocene, in agreement with the results of researches carried out in that time by the geologists of the Italian Geological Survey and by the stratigraphers of the University of Naples. As regards the original paleogeographic domain and the provenance of the Santa Croce Formation, Selli expresses three possibilities:

1) Provenance from an intraplatform basin originally located between the Venafro and the Mainarde mountains, today disappeared because of the tectonic shortening associated with the Valle Rotonda thrust;

2) Teleallochthony, with provenance from a Tyrrhenian domain;

3) Provenance from the Molise basin.

The conclusion of the Author is that «at the present state of the facts there are only clues or logical reasoning, which are too weak, and no concrete evidence that allows us to prefer one or the other of the three hypotheses».

A careful examination of the lower boundary of the Sannio Nappes, marked by a well evident dashed-anddotted red line in the fair copy and by a dotted red line in the field map, reveals some mistakes clearly related to the objective difficulty of tracing the Sannio/Molise tectonic contact by discriminating in the field between the variegated shales of the Serraparco Formation and the variegated shales of the Lame Formation. Figs. 10 and 11 are two clear examples. In fig. 10a varicoloured shales cropping out between Torrebruna and Castelguidone, originally mapped as Lame Formation with a grey colour, have been successively attributed to the Serraparco Formation as testified by superimposed violet marks. Finally, Selli attributed these variegated shales to the Serraparco Formation (see fair copy of fig. 10b), probably on the base of their geometric position, slightly modifying the original boundary between the Nappe I and Nappe II but forgetting to change the colour in the footwall of the contact (see small triangular-shaped outcrop in grey colour NNE of Trivento). In fig. 11 the contact between the Nappe I and Nappe II has been surely traced after the compilation of the fair copy as it cuts through an outcrop of variegated shales entirely attributed to the Lame Formation. In this case too it is evident that Selli forgot to change the colour of the variegated shales of the Volturara Appula outcrop, which from the Lame Formation had been transferred into the Serraparco Formation.

E) Neoparautochthonous and neoautochthonous formations

This group is represented by upper Tortonian-lower Quaternary sedimentary units that unconformably overlie the Apenninic nappes and the paleoautochthonous carbonates.

Why did Raimondo Selli decide to suspend the publication of his last regional work on the geology of Southern Italy? We will probably never know. It is certain, however, that this decision was not associated with problems of obsolescence of the geological model presented, given that the ideas presented in the unpublished paper, very different from those presented orally in 1962 at the Italian Geological Society, appear extremely modern considering the time at which they should have been published.

On superficial analysis the «Geological Map of Sannio and Surrounding Areas» could be considered as a document of purely historical value, the legend reflecting a scheme already surpassed by the same Selli in 1964. In reality, this map is far from obsolete because it appears as an objective restitution of the geological features of the study area, not at all influenced by preexisting conceptual models. The geological map of Selli is therefore an unexplored mine of data, still to be fully exploited, containing observations that are well worth recovering and studying in the case we wish to realize an efficient update of the geological cartography of the region. Products such as this are increasingly rare today because too often they are substituted by geological maps that derive from models instead of contributing to create them. On the base of these considerations, the Geological Map of Sannio and Surrounding Areas has been accurately digitised and posthumously published at the original scale 1:100,000 (SELLI, 2003).

The oldest of the present writers, who attended the session of the Italian Geological Society held in Rome in December 1962, would like to conclude these notes by remembering the expectation that there was for Selli's paper, the attentive silence that accompanied the presentation of the work and the long debate that animated the following discussion. Many young geologists were present, full of enthusiasm but arguably with a limited capacity to distinguish between first-order problems and marginal problems. These young geologists argued with the «baron», disputing many aspects of the proposed model, aspects that in their opinion contradicted the «objective» geological data. Raimondo Selli listened carefully to these criticisms and replied politely but very coldly, in the style of an «old university baron». None of those present could have imagined that very soon after the «old baron» would have given to those same young researchers a lesson of vivacity and scientific curiosity inviting them to discuss in the field the main points of disagreement. And this discussion, in effect, took place during a long fieldtrip in the Southern Apennines from Sannio to Basilicata. During this same trip, Selli defined a plan for an excursion (see SELLI, 1964) that the American Geological Institute wished to dedicate, precisely in 1964, to the geology of the Apennines.

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