1. Research activity (max 1.000 words)

General objective: Expanding our understanding of the Ligurian branch of the Alpine Tethys and of the so called AlKaPeCa [1] microplate.

Specific objective:space-time evolution of the Longobucco Basin (northern Calabria), which was part of AlKaPeCa [1], from the Early Jurassic rifting phase to the Cenozoic orogenic and post-orogenic phases.

Introduction

This project focuses on the study of the tectono/sedimentary evolution of the Longobucco basin (Sila Greca, Northern Calabria).

The Longobucco basin is currently part of the Calabria-Peloritani Arc and is characterized by a Meso/Cenozoic sedimentary succession covering the Hercynian basement, testifying the evolution of a continental margin during the Early Jurassic rifting phase. Even if the Early Jurassic rifting is a well documented event, some aspects are still debated. One of such aspects is the paleogeographic affinity and age of the so-called AlKaPeCa (Alboran-Kabilie-Calabria-Peloritani) microplate [1], also including the Longobucco Basin. The other Mesozoic basins belonging to AlKaPeCa in Calabria and the Peloritani Mountains are the Stilo Basin and the Longi-Taormina Basin.

The Mesozoic sedimentary cycle of the Longobucco Basin is divided into two Groups, reflecting the paleogeographic complexity generated by the oldest recorded extensional tectonic phase, which took place around the Sinemurian/Pliensbachian boundary. This first phase dismembered the basin into footwall (basin margins, structural highs) and hangingwall blocks, which are characterized respectively by the Caloveto and Longobucco Groups. In the latest Pliensbachian, a second extensional tectonic phase caused a rejuvenation of the basin margins and the demise of the benthic carbonate factories which grew attached to the footwall blocks. In the Longobucco Group,

sedimentation in the Rhetian/Hettangian to early Sinemurian interval was represented by continental red beds to shallow-marine deposits. These evolved upsectionto deeper-water marls and siliciclastic turbidites (late Sinemurian/Toarcian). Conversely, the Caloveto Group is characterized by shallow-water limestones (Lower Caloveto Fm.) with admixed siliciclastics, replaced by red nodular Rosso Ammonitico facies (Upper Caloveto Fm.) marking the drowning of the benthic factory. Starting inthe Aalenian, the two Groups shared a similar evolutionary pathway, with purely pelagic deposits of the canonical Tethyan triad (radiolarian cherts, *Saccocoma* and *Aptychus* limestones and "Maiolica"-like limestones). The clastic, megaclastic (plurimetric blocks) and turbiditic Paludi Fm. rests unconformably on the older units and represents the dismantling of an orogene. In the early Miocene, a compressional tectonic phase affected the basin, generating a series of imbricate tectonic slices made of antiformal and synformal structures. The late orogenic siliciclastic units (Serravallian – Messinian) unconformably cover all the older units.

In the latest years, studies of the Longobucco basin have been revived, evidencing the striking differences (and similarities) with other rift-basins like those known in the Umbria-Marche domain. During my master thesis [2], I discovered and mapped the preserved southwestern margin of the basin, previously interpreted as a generic tectonic contact, while [3] discovered and described the northern margin. These two margins intersect with an angle of ~65 degrees, thus resembling the shape of a pull-apart basin, developed along an en-echelon pattern of transcurrent faults; furthermore, the syn-tectonic Upper Pliensbachian-Lower Toarcian turbidites of (Trionto Fm.), 1000 m thick, suggest a sedimentation rate of 300mm/1000y, a value that far exceeds that of purely extensional basins. Both theses lines of evidence suggest that a strike slip component must have been active in the formation of the Longobucco basin. In this light it will therefore be necessary to identify and map the Southeastern margin, in order to restore, if possible, the full original shape of the basin and to confirm or rule out this working hypothesis.

Concerning the Paludi Fm., it is markedly underinvestigated despite its geological and geodynamic significance. The few Authors that studied it [4,5,6] disagree on its vertical organization and on its age (Cretaceous-Eocene vs. Aquitanian). This lack of information prevents us from correlating this Unit with comparable units (for example the Stilo-Capo d'Orlando Fm.) belonging to the CPA.

In a broader view, with regards to the study of the Calabria-Peloritani Arc in the context of the Meso/Cenozoic evolution of the Mediterranean region, the earliest attempts are due to [7,8] and

are still today very important reference texts. In the 80's [1] proposed for the first time the existence of a number of allochtonus crustal fragments of "European" provenance, accreted to the Apennine-Maghrebian chain due to slab roll-back. Bouillin grouped these fragments in the so-called AlKaPeCa microplate (Alboran, Kabylides, Peloritani and Calabria), separated from the southern European margin since the late Bajocian *via* a transcurrent branch of the Alpine Tethys. Currently [9] the concept of AlKaPeCa is widely accepted in the literature, but differs from that proposed by Bouillin and there is no consensus on the age of the rifting and drifting of this microplate from Europe, and on its paleogeographic position. Several Authors have focused through the years on the macroscale dynamics, by using mainly geophysical evidence in order to build reliable plate-kinematic restorations. Surprisingly, field mapping and classical tools like high-resolution stratigraphy and stratigraphic correlation across sedimentary basins have been often neglected. This is confirmed by the fact that a key element like the restoration of the original basin architecture through the identification in the field of preserved basin-margin tracts, is a very recent (and still incomplete) achievement.

Work plan:

1. This research will be based essentially on field work, through the geological mapping of selected areas on the 1:10.000/1:5000 scale. Mapping will be performed using FieldMove Clino. This application is dedicated to digital mapping, and makes it possible to measure and record all the geological body in a geo-referenced map. The FieldMove Clino data will be exported to Move, which will allow the production of 2D and 3D models.

2. In parallel with mapping, a mesostructural analysis will be conducted on the compressive structures (folds, thrusts), aimed at describing the interaction existing between the orogenetic structures and the inherited Early Jurassic extensional ones. A reconstruction of the Jurassic paleogeography and rift architecture will necessarily have to be preceded by the retrodeformation of compressive structures.

3. During my field work, which is focused on the Mesozoic succession, the Tertiary Paludi Fm. will be mapped and studied in order to assess its age and understand its geological significance. Although a syn-shortening significance for this formation has been widely accepted, numerous uncertainties still exist regarding: i) its age, in turn a constraint for the timing of tectonic inversion and deformation phases, and ii) how the different facies known in this unit (pelagic, turbiditic, megaclastic) are related to said deformation phases.

4. Another sub-field of research will be the study of analogies and differences between the Jurassic basins of Northern Calabria (Longobucco) and those in Southern Calabria (Stilo and Le Serre). As the Upper Jurassic succession known in the Stilo area is made, based on literature, of shallow-water shelf carbonates also including coral reefs, this comparative study will shed light on the relationships existing between different paleoenvironments within the AlKaPeCa microplate, and also with the southern European Tethyan margin (in the Mesozoic).

Bibliography

[1] Bouillin et al. 1986. *The origin of arcs, Elsevier*, 321 – 338.

[2] Innamorati & Santantonio, 2018. *Sedim. Geol.*, 376, 147-163.

[3] Santantonio et al. 2016. *Sedim. Geol.*, 331, 94 – 113.

[4] Magri et al. 1965. *Mem. Note Ist. Geol. Appl Univ. Napoli*, 9, 5 – 59.

[5] Bonardi et al. 2005. *Terra Nova*, 17, 331 – 337.

[6] Lanzafame & Tortorici 1980. *Riv. Ital. Paleont. Strat.*, 86, 31 – 54.

[7] Ogniben 1973. *Geologica Romana*, 12, 243 – 585.

[8] Amodio-Morelli et al. 1976. *Mem. Soc. Geol. Ital.*, 17 1 – 60.

[9] Handy et al. 2010. *Earth-Sci Rev.*, 102, 121 – 158.

2. Research products

a) Publications (ISI journals)

Innamorati G., Santantonio M., 2018**.** Evidence for extended Hercynian basement and a preserved Jurassic basin-margin tract in Northern Calabria (Southern Italy): The Longobucco Basin. *Sedimentary Geology*, 376, 147 – 163.

b) Publications (NON ISI journals)

c) Manuscripts (submitted, in press)

d) Abstracts

Innamorati G. & Santantonio M. - Sedimentological features of a preserved Early Jurassic basin margin. *Congresso SGI-SIMP: "Geosciences for the environment, natural hazard and cultural heritage" - Catania 2019*

Innamorati G., Fabbi S., Santantonio M. - The role played by varying trophic conditions within the same rift basin in the development of carbonate bodies fringing di_erent footwall blocks: the Lower Caloveto Fm. (Longobucco Basin - Sila Greca, Calabria). *Congresso SGI-SIMP: "Geosciences for the environment, natural hazard and cultural heritage" - Catania 2019*

Innamorati G., Di Cencio A., Fabbi S., Santantonio M. - New ammonite assemblages from northern Calabria (southern Italy): insights for Early Jurassic biostratigraphy and paleobiogeography. Presentazione orale XVII Congresso Società Paleontologica Italiana, Anagni 24 - 26 Maggio 2017

N.B. I dottorandi del primo anno al punto 1 possono inserire il riassunto del progetto di ricerca (max 1.000 parole)