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The Silurian of Sardinia: introduction to the field trip

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ABSTRACT - The general features of the Silurian of Sardinia are briefly outlined, with special respect to the two main facies suites exposed in the southeastern and southwestern parts of the island, respectively. An integrated biostratigraphical scheme with graptolite, conodont and chitinozoan zonations applied in the island is presented.

KEY WORDS - Silurian, Sardinia, Biostratigraphy.

INTRODUCTION

This paper represents a short introduction to the field trip in Sardinia, as a part of the International Subcommission on Silurian Stratigraphy Field-Meeting 2009. More detailed information on geology, stratigraphy and palaeontology of the Silurian of Sardinia are present in the volume "The Silurian of Sardinia" (Corradini et al., 2009) and in the description of the single stops (this volume).

GEOLOGICAL OVERVIEW

The Palaeozoic Basement of Sardinia is a part of the South European Variscan Chain (Carmignani et al., 1992 and references therein). This is evidenced by the stratigraphical and structural features shared with other Variscan massifs of Southern Europe and by palaeomagnetic data. The Variscan Orogeny affected the whole Sardinian Basement producing various degrees of deformation and metamorphism followed by extensive post-collisional magmatism. The Sardinian Basement represents a complete section across the south-verging branch of the Variscan Chain (Fig. 1a). This chain segment has a NW-SE orientation and shows a tectono-metamorphic zonation typical of continental collisional chains (Carmignani et al., 1992).

The regional metamorphism makes it possible to recognize a Nappe Zone developed between the Metamorphic High Grade Complex in northeastern Sardinia and the autochthonous Foreland Zone in the southwestern part of the island. In that Nappe Zone we can distinguish external nappes (Sarrabus Unit, Gerrei Unit, Arburese Unit) from internal nappes (Nurra Unit, Baronie Unit, Gennargentu Unit). In the Foreland Zone and the External Nappe Zone, the original lithological features and the palaeontological content have been preserved thanks to only weak tectonic deformations and low-grade metamorphism.

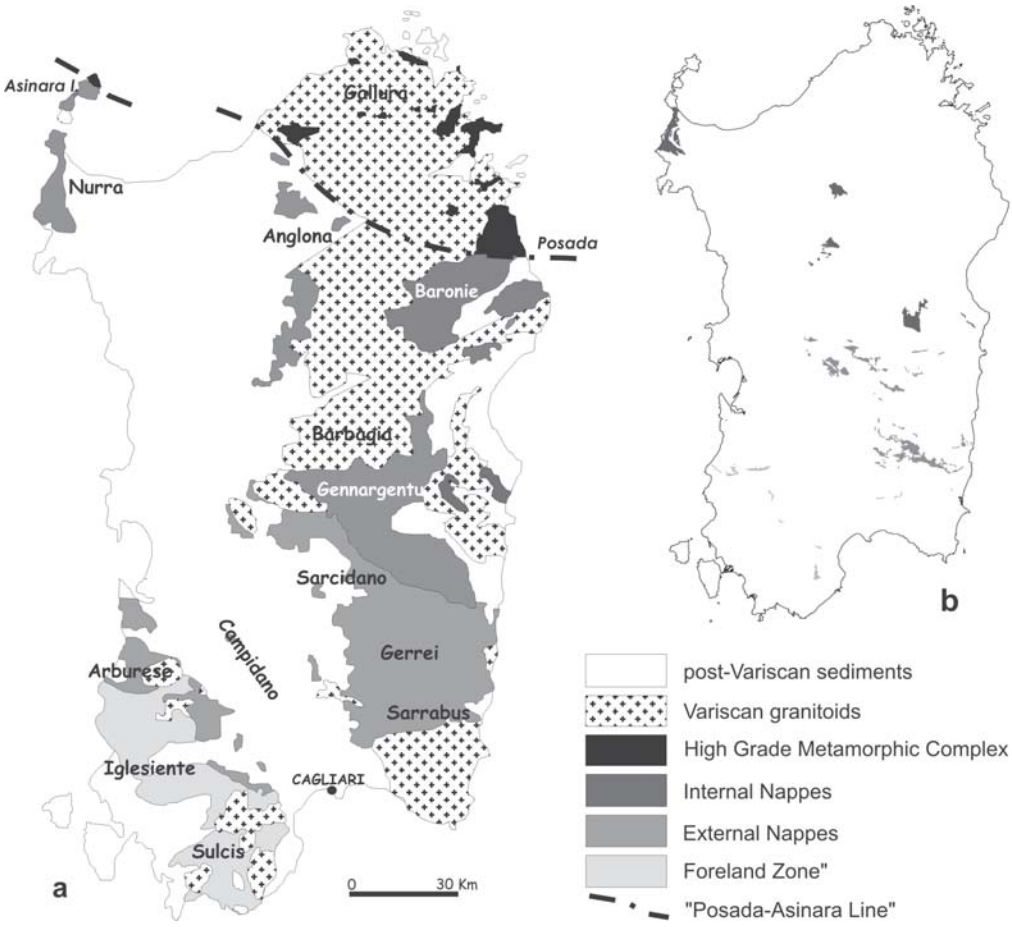

Fig. 1 - a) Simplified structural map of Sardinia (after Carmignani et al., 1992, mod.); b) Silurian outcrops in Sardinia (after Carmignani et al., 2001, mod).

The Silurian of Sardinia

Silurian rocks are discontinuously exposed in several sub-regions of Sardinia (Fig. 1b), but have been studied in detail only in the southern part of the island, because of the weak metamorphism.

Two distinct Silurian stratigraphical sequences occur in the External Nappe Zone (mainly southeastern Sardinia) and in the Foreland (southwestern Sardinia) (Fig. 2): they remind to the coeval sequences exposed in Thuringia and central Bohemia, respectively.

Southeastern Sardinia

In southeastern Sardinia the Silurian and lowermost Devonian are represented by the classical Thuringian facies triad: Lower Graptolitic Shales, Ockerkalk and Upper Graptolitic Shales. The older unit is widely exposed in the Sarrabus tectonic Unit, but the most complete and extensively studied sequence is exposed in the Gerrei tectonic Unit (Corradini

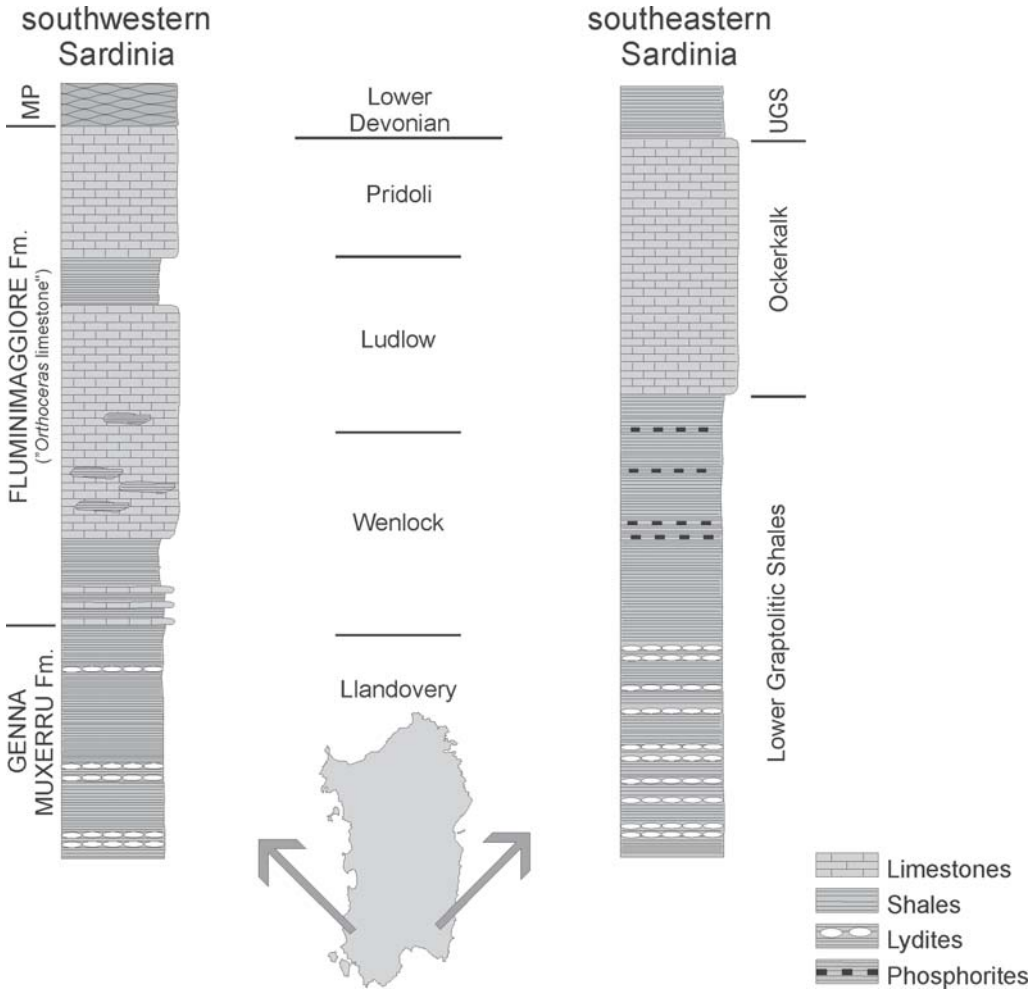

Fig. 2 - Sketched stratigraphical columns (not to scale) of the Silurian and lowermost Devonian of Sardinia. MP: Mason Porcus Formation; UGS: Upper Graptolitic Shales.

& Ferretti, 2009 and references therein). It starts with about 30-40 metres of graptolitic silica-argillaceous and silty shales (Lower Graptolitic Shales [*stop 1 – Rio Ollastu; stop 2 – Lantini Tunnel; stop 4 – Goni; stop 5 – Sedda de S'Ortu*], rich in carbon and pyrite ("alum slates" of Jaeger, 1977) and interbedded with lydites in the lower part. This unit extends into the early Ludlow, at least up to the *nilssoni-colonus* Biozone (Storch & Piras, 2009). Graptolites are the only fossil group abundant in this unit; chitinozoans, microplankton and sponge spiculae have been also reported.

The Lower Graptolitic Shales grade into the overlying Ockerkalk [*stop 2 – Lantini Tunnel*].

The Ockerkalk [*stop 6 – Silius; stop 7 – Genna Ciuerciu*], 25 m thick, is an argillaceous limestone with a blue-grey colour weathering to ochre (so the name) and having a typical irregular flaser texture. Loboliths and crinoidal stems are the only fossils clearly visible in

the outcrops; the other fauna comprises few nautiloids, rare ostracodes, brachiopods, thin-shelled bivalves, trilobite fragments, gastropods, sponge spiculae, phyllocarids (mainly mandibles) and crinoids. All these organisms are scattered in a micritic limestone, only locally concentrated in thin wackestone bands of disarticulated debris. A rich conodont fauna, spanning from early Ludlow to late Pridoli, has been recovered from these limestones (Corriga et al., 2009 and references therein).

The boundary between the Ockerkalk and the overlying Upper Graptolitic Shales is never exposed, due to the strong tectonics; however, biostratigraphical data from the two units suggest that the formation boundary is more or less coincident with the Silurian-Devonian boundary.

The Upper Graptolitic Shales [*stop 3 – Sa Ruinosa*], about 30 m thick, are composed by alum slates (Barca & Jaeger, 1990). Pelagic graptolites are the only abundant fossils found throughout the unit (Jaeger, 1977; Piras & Paschina, 2009). Crinoidal stems, calyces and possible loboliths occur in the lowermost part of the unit.

Southwestern Sardinia

Silurian rocks of southwestern Sardinia are, from a palaeontological point of view, among the best known sediments of the whole Palaeozoic succession of the island. However, despite the richness and the good preservation of the fossil material, outcrops are in general quite disappointing, since only a few meters of rocks, normally strongly tectonized, or a group of scattered blocks are exposed here and there, without any undisturbed section [*stop 11 – Perd'e Fogu*]. Two formations (Fig. 2) were formally described by Gnoli et al. (1990) in the Silurian of southwestern Sardinia: the Genna Muxerru Formation (Llandovery) and the Fluminimaggiore Formation (uppermost Llandovery-lowermost Lochkovian).

The Genna Muxerru Fm. [*stop 9 – Monte Cortoghiana Becciu*] consists of 20-25 m of graptolitic silica-argillaceous and silty shales. The Fluminimaggiore Fm. [*stop 10 – Funtanamare; stop 11 – Perd'e Fogu*] overlies the Genna Muxerru Fm. Its thickness, estimated only indirectly due to the strong tectonism, is 45-50 m. The formation spans from late Llandovery to the earliest Lochkovian. Black calcareous lenticular layers alternate with dark non-calcareous pelites and shales. Plastic deformation and cleavage strongly affected the shales while limestone blocks preserve fossils mostly in three dimensions. The black colour and the bituminous smell reflect the high content of organic matter. The fauna is dominated by cephalopods and bivalves, associated with pelagic ostracodes, graptolites, conodonts, chitinozoans and muellerisphaerids, whereas gastropods, brachiopods, trilobites and phyllocarids are rare. Graptolites are frequently found packed together in peculiar pseudo-lenticular calcareous bodies. The Fluminimaggiore Fm. is overlain by the Mason Porcus Formation [*stop 10 – Funtanamare*] (Lochkovian-Emsian), which mainly consists of nodular and massive limestones alternating with compact dark siltstones and shales.

Biostratigraphy

A detailed biostratigraphy of the Silurian of Sardinia has been elaborated on the basis of conodonts and graptolites found in the limestones and in the shales, respectively. Regional zonation schemes (Fig. 3) have been provided both for conodonts (Corradini & Serpagli, 1999; Corriga et al., 2009) and graptolites (Storch & Piras, 2009), while a few zones have been proposed for chitinozoans, too (Pittau & Del Rio, 2009). Furthermore,

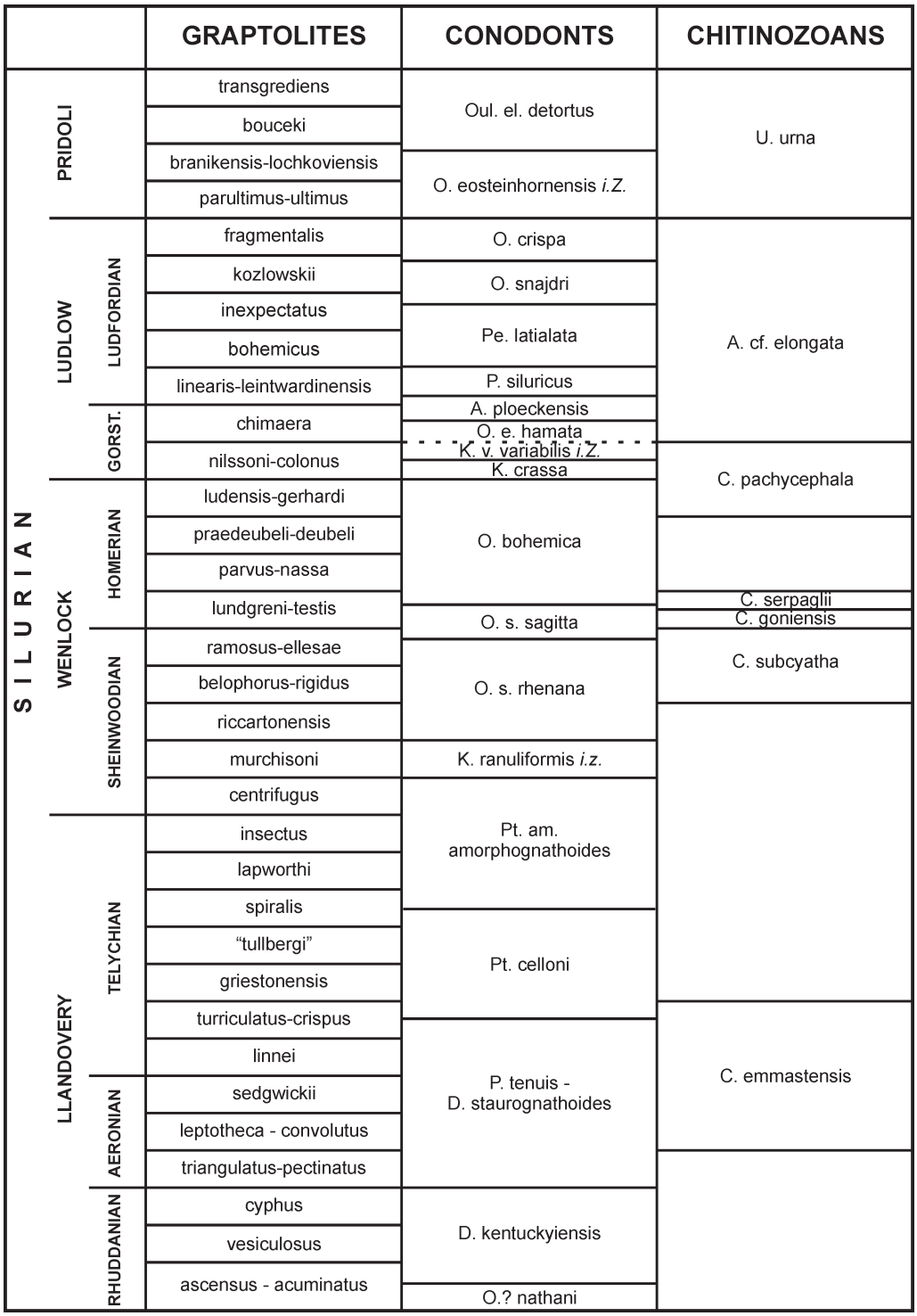

Fig. 3 - Graptolite, conodont and chitinozoan zonal schemes used in Sardinia. Graptolite scheme after Storch & Piras (2009); conodont scheme after Corradini & Serpagli (1999) and Corriga et al. (2009); chitinozoan zones after Pittau & Del Rio (2009).

the joint occurrence of conodonts and graptolites in the graptolitic limestones of the Fluminimaggiore Fm. allows a good tying of the two zonation schemes in some time intervals.

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