

The Gerrei tectonic Unit (SE Sardinia, Italy)

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The Gerrei tectonic Unit is one of the main units of the External Nappes Zone of Central-Southern Sardinia. It represents the unit bearing the most complete Lower-Middle Palaeozoic sequences, which were only mildly affected by metamorphic effects. Most of its components are not yet officially defined and informal names are still in use in literature (so our citations in inverted commas).

Thick terrigenous sediments, known as San Vito Sandstones (Calvino, 1961) and probably exceeding 500 m in thickness, are present at the base of the Gerrei Unit (Fig. 1). Monotonous alternances of grey micaceous sandstones, quartzites, siltites and pelites grade to levels of violet, greenish or blackish pelites and thick layers of coarse light-grey quartzites and conglomerates. Rare recrystallized grey unfossiliferous limestones are intercalated in the upper part. The age of this part of the Gerrei Unit spans from Middle Cambrian to Early Ordovician (Tremadoc-Arenig) on the basis of a rich acritarch association there recovered (Barca, 1998 and references herein). A wide submarine fan-delta system, swept by turbidity currents, was inferred (Barca & Di Gregorio, 1979; Barca *et al.*, 1981; Barca & Maxia, 1982).

The San Vito Sandstones are unconformably covered (Sarrabese Phase) by an "Ordovician volcanic complex" (volcanites, volcanoclastites and epiclastites), up to 400-500 m thick. These volcanic products have calc-alkaline affinity and the composition varies from acid (rhyolites and rhyodacites) to intermediate and basic (andesites and basalts) (Carmignani *et al.*, 1992). The top of the complex ("Porfiroidi" *Auct.*) is represented by whitish rhyolites and grey rhyodacites (flows, ignimbrites and tuffs). The origin of these volcanic products is a magmatic arc, which existed for most of the Ordovician (Arenig to Caradoc), related to subduction of oceanic crust under the North Gondwanian continental margin (Carmignani *et al.*, 1992).

The subduction ceased in the Late Ordovician and the following gravitative collapse of the magmatic arc produced extensional stresses associated with basaltic intercalations in terrigenous continental to littoral sediments. Quartzites, sandstones and rarely conglomerates, greyish siltites and argillites with variable carbonatic content were deposited ("Caradocian transgression"). Lateral variations in facies and thickness, mostly at the base of the sequence, reveal the former irregular palaeotopography. The fossil content of this part of the Gerrei Unit is very scarce and limited to reports of cystoids, brachiopods and solitary corals (Helmcke, 1973; Helmcke & Koch, 1974; Naud, 1979). A rich bryozoan association, mostly composed of cryptostome bryozoans, was described by Conti (1990). The topmost calcareous beds, locally silicified, are constituted by echinoderm- or bryozoan packstones (Fig. 2) intercalated in fossiliferous mudstones with bryozoan, echinoderm, brachiopod and trilobite debris. Rare ostracodes are also present. Conodonts from these limestones have recently documented the Late Ordovician (Ashgill) *Amorphognathus ordovicicus* Zone (Ferretti *et al.*, 1998a, b; Ferretti & Serpagli, 1999). The conodont

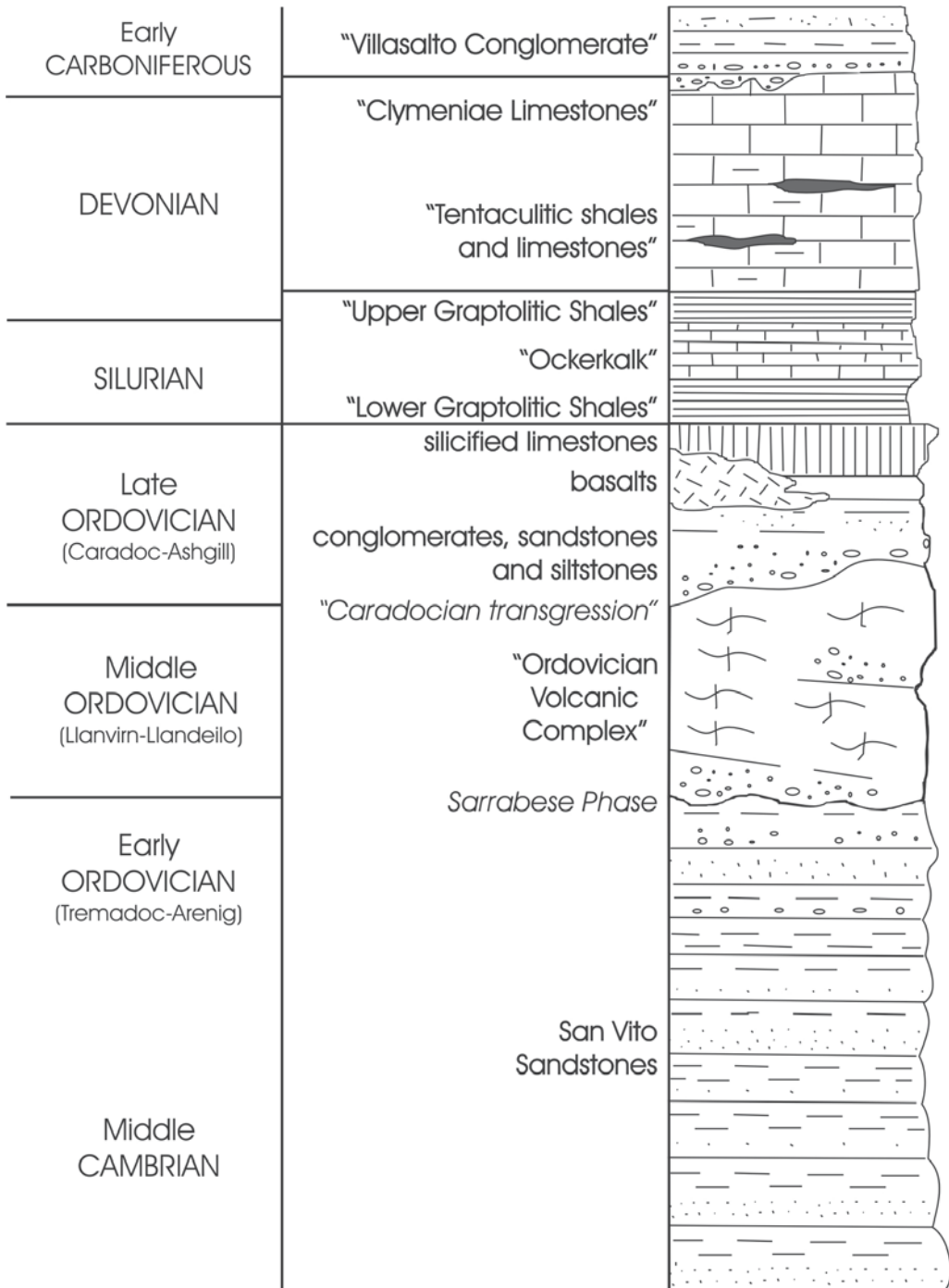


Fig. 1 – Stratigraphic column of the Gerrei tectonic Unit (not to scale). Modified after Corradini *et al.* (2002, in press).

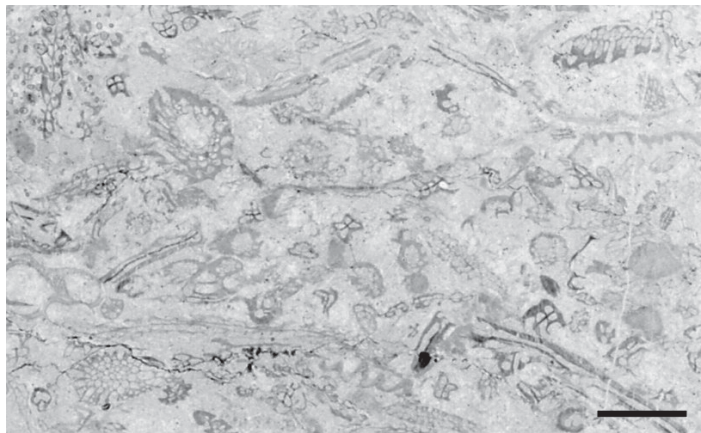


Fig. 2 – Bryozoan packstone with echinoderm debris. Sample Umbrarutta 15, Late Ordovician. Scale bar=2 mm.

association has a typical mixed character and suggests faunistic interchange with both the British and Baltic conodont provinces. Sardinia probably occupied an outer position of lower latitudes compared to the typical North-Gondwanian regions of the circumpolar belt (Ferretti & Serpagli, 1999).

The Silurian and Early Devonian are represented by a calcareous unit (“Ockerkalk”) sandwiched between two shaley units (“Lower Graptolitic Shales” and “Upper Graptolitic Shales” respectively) (Fig. 4). A very close situation occurs in Thuringia (Jaeger, 1976, 1977). The “Lower Graptolitic Shales” (30–40 m) are silica-argillaceous and siltitic shales rich in carbon and pyrite (“alum slates”; Jaeger, 1977). Lydites (cherts) are interbedded in the lower part as well as phosphorites occur in the middle-upper part of the unit. Graptolites (Fig. 3) are the most important fossils of this unit. Numerous graptolite zones of Llandovery to earliest Ludlow age have been so far documented (Fig. 4) (Jaeger, 1977; Barca & Jaeger, 1990).

The “Ockerkalk” (25 m thick) is an argillaceous flaser limestone with a blue-grey colour weathered to ochre, from which its name is derived. Crinoidal stems and rare cephalopods are the only macrofossils recognizable in the outcrop. Trace fossils and very small solitary corals were reported from the “Ockerkalk” by Jaeger (1977). The lobolith-horizon with bulbous holdfasts of giant pelagic scyphocrinoids, well known across the Silurian/Devonian boundary along the Northern Gondwana margin, occurs in the upper part of this unit. Microbiofacies analysis reveals fine micritic limestones with a fossil content (ostracodes, brachiopods, thin-shelled bivalves, trilobite and echinoderm fragments, gastropods, sponge spiculae) scattered in the matrix and only locally concentrated in millimetric shell-lags of disarticulated debris (Barca *et al.*, 1995; Ferretti & Serpagli, 1996). Phyllocarids (mainly mandibles) were recovered from the conodont heavy-fraction. The precise age location of the unit has been possible with the recent description of a rich conodont fauna of Ludlow-Pridoli age (Fig. 4) spanning from the *Oz. e. hamata* to the *O. e. detortus* zones (Barca *et al.*, 1995; Corradini & Olivieri, 1997, Corradini *et al.*, 1998, 1999, 2000; Serpagli *et al.*, 1998).

The “Upper Graptolitic Shales” (about 30 m) are exclusively composed of alum slates (Barca & Jaeger, 1990). Pelagic graptolites are the only abundant fossils found throughout the unit (Jaeger, 1977). Rare *Ceriatocaris* (Jaeger, 1977) and a single specimen of pterineid bivalve (Barca & Jaeger, 1990) have been so far recorded. According to the composite section proposed by Barca & Jaeger (1990), *Scyphocrinites* also occurs in the lower part



Fig. 3 – “Lower Graptolitic Shales”, level with *M. prae-deubeli*, (Wenlock), identified by H. Jaeger (1987, pers.com.). Goni Section. Scale bar =1 cm.

of the unit. The lowermost Devonian graptolite biozones *uniformis*, *praehercynicus* and *hercynicus* were documented in the Baccu Scottis section (Jaeger, 1976, 1977). The base of the Devonian is therefore more or less coincident with the “Ockerkalk”-“Upper Graptolitic Shales” boundary.

A few meters of poorly fossiliferous, thin nodular grey limestone may locally cover the shales, which otherwise grade to an alternation of dark and black phyllites and nodular limestones yielding tentaculites (Carosi *et al.*, 1992). On the basis of tentaculites, the age of this complex may be referred to the Early Devonian (Late Lochkov-Emsian; Alberti, 1963; Gessa, 1993), or even to the Middle Devonian (Eifelian; Gessa, 1993). The tentaculite unit grades to marly limestones for a thickness difficult to establish owing to possible tectonic repetitions. Conodont data from sporadic outcrops have documented the Middle Devonian, but the absence of continuous undisturbed sections has so far prevented a detailed study.

The succession continues with a thick sequence of massive limestone (“Calcari a Clymeniae”; Lovisato, 1894) yielding clymenids and goniatites in some levels (Fig. 5). Its apparent thickness reaches hundreds of meters but tectonic repetitions are possible (Carmignani *et al.*, 1986). Ammonoids, apart a few crinoid stems, are the only abundant macrofossils. Rare brachiopods and fish teeth have been also reported (Corradini, 1998b). The microfacies is always represented by poorly fossiliferous micrites, with a few fossil remains (ostracodes, echinoderms, gastropods, trilobites, etc.) only in the ammonoid-bearing beds (Corradini, 1998a, b). The age of the unit has been investigated on the basis of a rich and well preserved conodont fauna. Part of this massive complex in the Villasalto area was carefully stated as latest Devonian (Famennian) by Olivieri (1965, 1970) and Corradini (1998a, b). Recently, an early Carboniferous age (Tournaisian) for the topmost

Fig. 4 – Stratigraphic distribution of the Silurian-lowermost Devonian units in the Gerrei sub-region (documented biozones are shaded). Photographs on the right: “Lower Graptolitic Shales”, Sedda de S’Ortu Section, *turriculatus* Zone; “Ockerkalk”, Silius II Section, Pridoli; “Upper Graptolitic Shales”, calyx of scyphocrinoid [left], Baccu Scottis Section, scale bar: 4 cm; *M. uniformis* [right], Goni Section, scale bar: 1 cm.

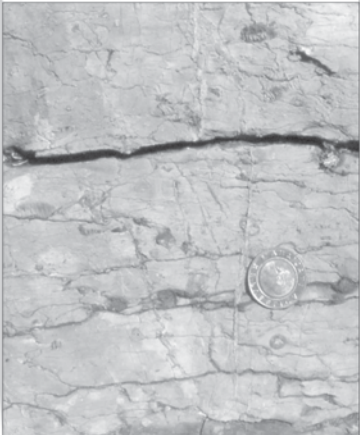
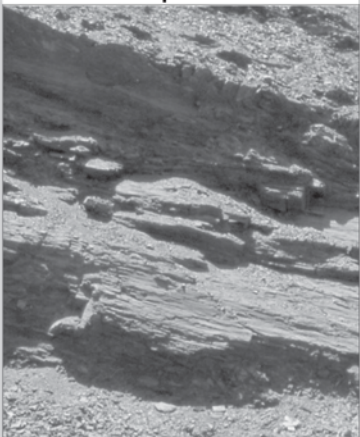
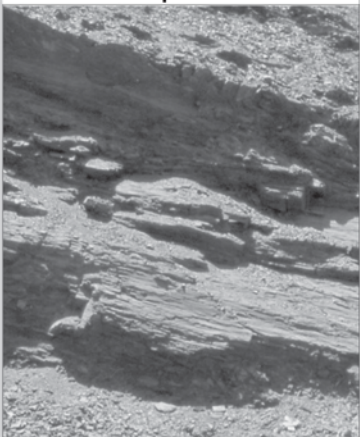
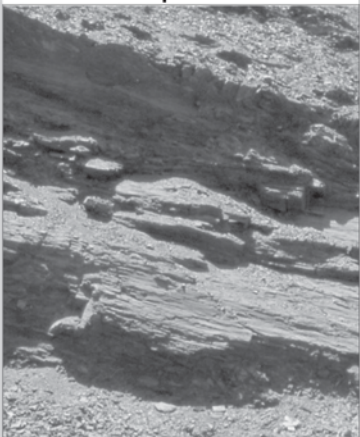
		GRAPTOLITES	CONODONTS	“Upper Graptolitic Shales”								
DEVONIAN	Early (pars)	hercynicus	Pe. pesavis	 								
		praehercynicus	A. delta									
		uniformis	O. eurekaensis I. w. woschmidtii									
PRIDOLI	bouceki-trasgrediens	Oul. el. detortus										
	branikensis-lochkoviensis	O. remscheidensis i.Z.										
	parultimus-ultimus											
LUDLOW	formosus	O. crista										
	kozłowski-boh.tenuis	O. snajdri										
									Pe. latialata			
	leintwardinensis	P. siluricus										
	scanicus	A. ploeckensis										
	nilssoni	O. e. hamata K. v. variabilis i.Z. K. crassa										
WENLOCK		ludensis							O. bohemia			
	praedeubeli-deubeli											
	parvus-nassa											
	lundgreni	O. s. sagitta										
	rigidus-perneri	O. s. rhenana										
	riccartonensis-belophorus	K. ranuliformis i.z.										
	centrifugus-murchisoni	Pt. am. amorphognathoides										
lapworthi-insectus												
spiralis i.Z.												
LLANDOVERY	griestonensis-crenulata	Pt. celloni										
	turriculatus-crispus											
	guerichi											
	sedgwickii	P. tenuis - D. staurognathoides										
	convolutus											
	argenteus											
	triangulatus-pectinatus											
	cyphus											
	vesiculosus											
	acuminatus	O. ? nathani										



Fig. 5 – Slab of “Clymeniae Limestones”. Pranu Scandariu Section, Late Devonian.

levels of the unit exposed in the Monte Taccu area was documented (Barca *et al.*, 2000; Corradini *et al.*, 2002). Furthermore, Frasnian (Late Devonian) conodonts have been recovered from a few different localities (Corradini, unpublished data). The age of the “Clymeniae Limestones” spans therefore from Late Devonian to Early Carboniferous. A pelagic deposition environment may be supposed, both on the basis of microfacies and absence of benthonic fauna; furthermore, also the conodont biofacies indicate an off-shore environment (Corradini, 1998a, b). During the Early Carboniferous, owing to a decrease of typical pelagic genera, the conodont biofacies analysis suggests a very slight shallowing (Corradini *et al.*, in press).

Several dozen meters of sandstones and conglomerates (“Conglomerato di Villasalto”, *Auct.*) are present above the “Clymeniae Limestones”. They represent the transition to the terrigenous sedimentation which ends the pelagic sequence of the Palaeozoic in SE Sardinia (Teichmüller, 1931; Barca & Spalletta, 1985). These sediments are interpreted as synorogenic deposits accumulated in foredeep basins located between the advancing nappe front of the Sardinian Hercynian Chain and the foreland or “External Zone” represented by the Iglesias-Sulcis area (Barca, 1991; Barca & Olivieri, 1991; Barca *et al.*, 1992; Barca & Eltrudis, 1994). They are represented by irregular alternances of sandstones, quartzites and dark-grey siltites, with frequent intercalations of polygenic conglomerates and breccias bearing clasts of Silurian “lydites” and, rarely, volcanites (Barca, 1991; Di Pisa *et al.*, 1992). Calcareous megablocks and olistostromes up to hundreds of meters in size also occur. Abundant conodont faunas provided by some calcareous pebbles and exotic blocks documented various stages of the Devonian (Barca & Spalletta, 1985; Barca & Olivieri, 1991).

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