

Cala d’Inferno: geological overview

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LOCALITY Cala d’Inferno (Fig. 1), a small bay on the west side of the Capo Caccia peninsula (approx. 7 km west of Alghero), owes its origin to the erosion of the Purbeckian marls, which are situated between the hard and well-bedded Tithonian limestones forming the cliff to the west (altitude 125 m) and the escarpment of the massive Urgonian limestones (Punta Malrepos, 141 m) to the east (Fig. 2A, B).

AGE Oxfordian-Kimmeridgian to Valanginian.

LOCATION

View from the eastern border of Cala d’Inferno to the steep northern coast of this bay.

HISTORICAL OUTLINE

For the first time, Maxia & Pecorini (1963) pointed out the continuous transition between Jurassic and Cretaceous at Cala d’Inferno and recognized the existence of a marly Purbeckian facies with ostracods and algae between the Malm and the Urgonian. In a brief description of the section, Pecorini (1965) differentiated Portlandian, Purbeckian and Neocomian with their respective faunal and floral elements. The same author (Pecorini, 1969) studied the Clavatoraceae (charophytes) from the Purbeckian of this locality, for which he envisaged a Valanginian age. In that paper he gave a detailed description of the species *Flabellochara groovesi* (Harris), *Perimneste* cf. *horrida* Harris, *P. micrandra* Grambast, and established the new taxon *Globator maillardi* (Saporta) *nurrensis*. In another paper, Pecorini (1972) documented the dasycladacean algae occurring in marine intercalations within the Purbeckian facies and established the microporellid *Lacrymorphus catenaeformis* Radoicic *sardus* n. subsp.

Chabrier & Fourcade (1975) correlated the entire Purbeckian of Cala d’Inferno (overlying the limestones of “Portlandien probable – Berriasien?” age) with the Berriasian and Valanginian (pro parte), and cited from the lower part of this series the ostracods *Fabanella* gr. *polita* and *Cypridea* gr. *bispinosa* Martin (det. R. Damotte). From the middle part of the series they mentioned *Protocythere* cf. *divisa* Oertli and *Macrodentina* cf. *mediostriata transfuga* Malz as well as the luluolid foraminifer *Macroporella embergeri* Bouroullec & Deloffre. In the lower part of the overlying Urgonian limestones they found a typical Valanginian foraminiferal association (see stop 3.5.2). The same assemblages were also reported by Azéma *et al.* (1977).

On the occasion of the 19th European Micropaleontological Colloquium, Cherchi & Schroeder (1985a) gave a detailed description of the Cala d’Inferno section. Colin *et al.* (1985) studied the charophytes and ostracods of the Purbeckian facies. In that latter paper, Feist & Grambast-Fessard described the charophytes *Musacchiella sardiniae* n. sp.,

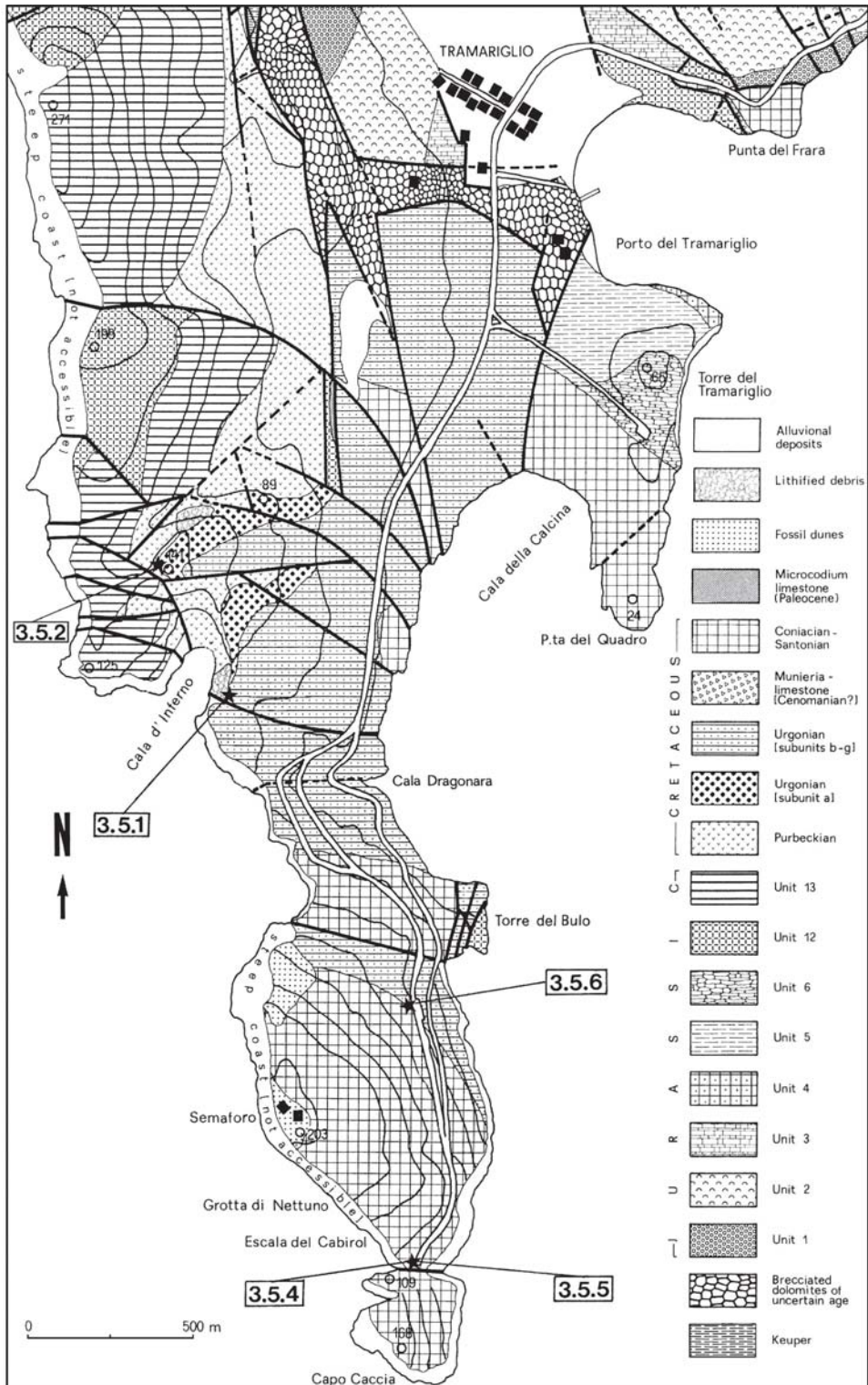


Fig. 1 - Geological map of the Capo Caccia region, with indication of today stops (after Haehnel, 1983, mod.).

Musacchiella maxima (Donze) Feist & Grambast-Fessard n. comb., and *Globator nurrensis* (Pecorini) Grambast n. comb., while Colin established the ostracods *Cypridea dorsoinclinata* n. sp., *Cypridea tumescens meridionalis* n. ssp., and *Theriosynoecum sardum* n. sp. Cherchi & Schroeder (1985b) revised the microproblematicum *Lacrymorphus catenaeformis sardus* Pecorini, 1972, occurring in the uppermost part of the Purbeckian, and assigned it under the name *Sarfatiella sarda* n. comb. to the dasycladaceans.

LITHOLOGY AND PALAEOBIOLOGICAL CONTENT

The upper Jurassic and lowermost Cretaceous series of Cala d'Inferno are well exposed, but hardly accessible, on the steep northern coast of this bay, where they dip with 25° to 30° to SE. The following lithological units can be observed:

1. Dolomites (Oxfordian – Kimmeridgian)

The cliff forming the western part of the steep coast consists at its base of grey to dark, sometimes brecciated and nearly unfossiliferous dolomites.

2. Limestones (Tithonian)

The dolomites mentioned before are overlain by well bedded, hard, light-brown to beige micritic limestones (approx. 45 m; thickness of beds: 30-50 cm), forming the cliff west of Cala d'Inferno (altitude 125 m). The fossil content, mainly consisting of dasycladaceans and foraminifera, increases towards the top of the succession. Azéma *et al.* (1977) have found in the lower part the dasycladaceans algae *Clypeina jurassica* Favre, *C. solkani* Conrad & Radoicic, *Salpingoporella annulata* Carozzi, and *Actinoporella podolica* (Alth); from the upper part they cited miliolids, *Ophtalmidium* sp., *Trocholina alpina* (Leupold), and the coprolite *Favreina prusensis* (Parejas). The upper part of these limestones contains some marly, charophyte-bearing intercalations indicating the gradual transition from the marine environment to the subsequent lacustrine Purbeckian facies.

3. Marls and marly limestones (Berriasian).

The contact between the foregoing limestones and the stratigraphically following Purbeckian succession is a nearly vertically directed faulted zone (Fig. 2D, left border), so that the transition between these two formations cannot be observed at this locality. The Purbeckian beds bordering this faulted zone eastward are dragged upwards and highly disturbed (Fig. 2D).

a. The lower part of the Purbeckian beds (approx. 30 m) consists of predominantly lacustrine, green-greyish or light-grey marls or marly limestones, in part unfossiliferous, but frequently very rich in charophytes and ostracods. The upper part of this subunit is marked by a 1.5 m thick yellowish marly limestone bank (horizon LB 2; see Fig. 2C). A second key horizon is a hard and dark grey-brownish limestone ledge (1.5 m thick), which is situated approx. 7 m below the top of the subunit; it is characterized by abundant charophyte remains (horizon LB 1). A light-grey soft marly bed (=sample CI-2 in Colin *et al.*, 1985; see Fig. 2C), situated approx. 17 m below the top of the lower subunit of the Purbeckian succession, has yielded the ostracod *Fabanella boloniensis* (Jones). Yellowish marly limestones with abundant charophytes and ostracods (= sample CI-5 in Colin *et al.*, 1985; see Fig. 2C), situated immediately at the base of the key horizon LB 2 (= top of the lower subunit of the Purbeckian) contain the following taxa:

Charophytes (det. M. Feist & N. Grambast-Fessard)

Musacchiella maxima (Donze) Feist & Grambast-Fessard, *Flabellochara* aff. *grovesi* (Harris) Grambast, *Perimneste micrandra* Grambast, *Globator nurrensis* (Pecorini) Grambast.

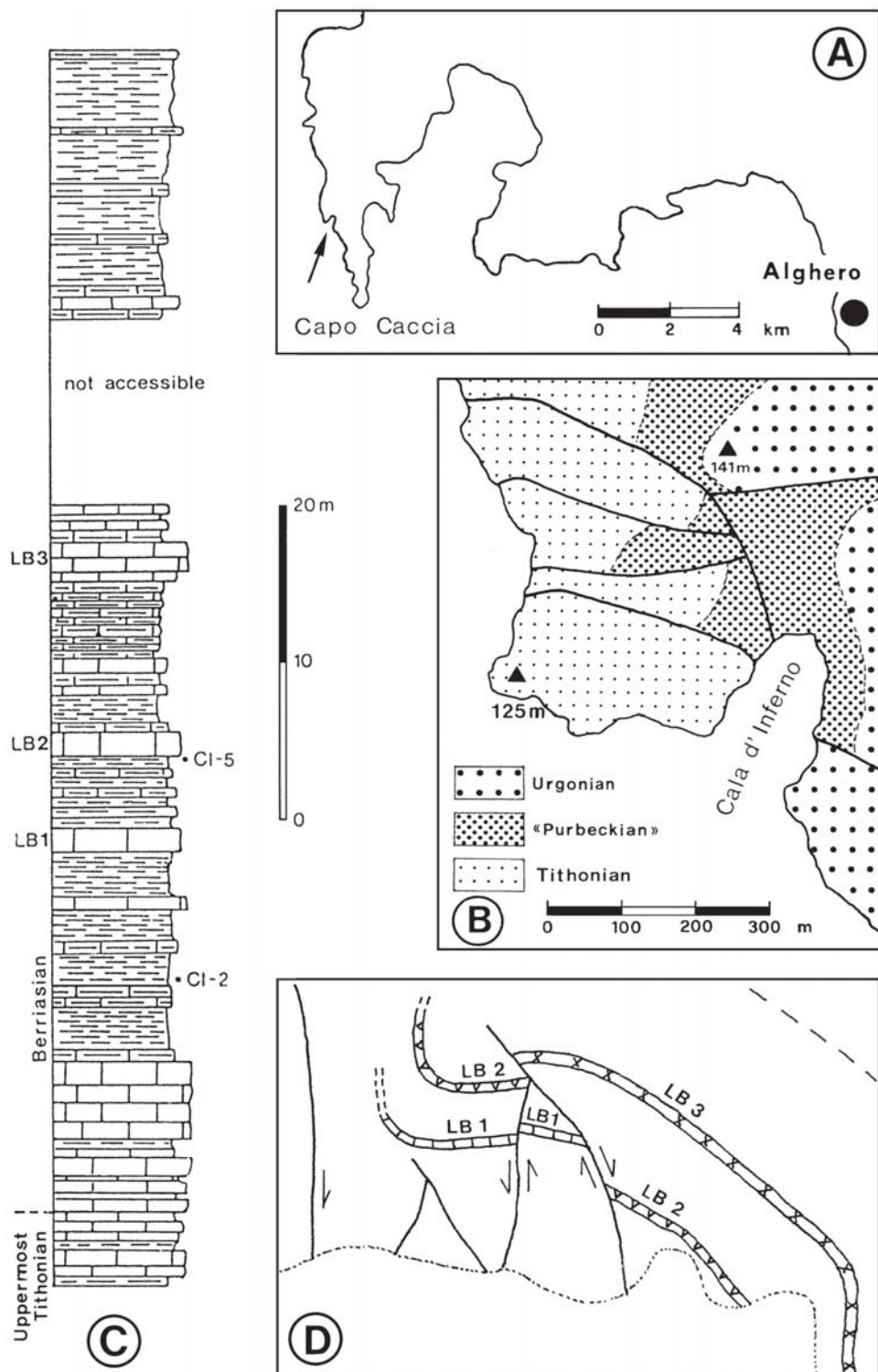


Fig. 2 – Cala d'Inferno (Capo Caccia peninsula). A: Location (arrow); B: Geological map; C: Lithological section of the Purbeckian series with location of the samples CI-2 and CI-5; D: Tectonics within the Purbeckian.

Ostracods (det. J.-P. Colin)

Cypridea tumescens meridionalis Colin, *Cypridea* cf. *vidrana* Wolburg, *Cypridea* cf. *protogranulosa* Anderson, *Cypridea dorsoinclinata* Colin, *Theriosynoecum sardum* Colin, *Dictyocythere* gr. *mediostricta* Sylvester-Bradley, *Protocythere* cf. *divisa* Oertli

This horizon is the type level of the ostracods *Cypridea tumescens meridionalis* Colin, *Cypridea dorsoinclinata* Colin and *Theriosynoecum sardum* Colin.

b. The upper part of the Purbeckian deposits (approx. 45 m) consists of grey-greenish, detritic, sometimes pseudoolitic marls, marly limestones of hard limestones. This part is characterized by numerous relatively short brackish or marine intercalations, which become more frequent towards the top of the succession.

4. Basal Urgonian limestones (uppermost Berriasian? – lowermost Valanginian).

The Purbeckian beds are overlain by hard Urgonian limestones; their basal part forms a well marked morphological ridge running up to Punta Malrepos (for further information see Stop 3.5.2).

AGE

1. The age of the dolomites (Unit 1) at the base of the steep coast can be indirectly deduced from the under- and overlying fossiliferous limestone formations as Oxfordian-Kimmeridgian.

2. The dasycladaceans association of Unit 2 (Azéma *et al.*, 1977) indicates a Tithonian to lower Berriasian age of this formation (Bassoullet, 1997). Haehnel (1983) found near Punta Cristallo (4.5 km north of Cala d'Inferno) in the transitional beds between the marine Unit 2 and the lacustrine Purbeckian (Unit 3) the dasycladacean algae *Salpingoporella annulata* Carozzi and *Heteroporella lemmensis* (Bernier) (det. M.-A. Conrad, Genève). The latter species ranges from the Kimmeridgian to the Jurassic – Cretaceous boundary (Bassoullet, 1997). Therefore, the transition between the Units 2 and 3 took place at the Tithonian - Berriasian boundary.

3. The age of the lower part of the Purbeckian (Unit 3) can be specified by the ostracod fauna and the charophytes. *Fabanella boloniensis* Jones (sample CI-2; see Fig. 2C) appears in the Berriasian and ranges up to the Aptian. The ostracod fauna of sample CI-5 is of Berriasian age (Colin *et al.*, 1985). According to Feist & Grambast-Fessard (*in* Colin *et al.*, 1985), the charophyte assemblage of sample CI-5 lacks elements of the early Berriasian flora; they attribute this association to the late Berriasian.

4. For the age of the terminal Purbeckian beds and the basal part of the overlying Urgonian see Stop 3.5.2 (Punta Malrepos: Urgonian transgressive limestones on Purbeckian facie).

Financial support was provided by grants from MURST (Cofin and ex 60%).

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