THE CASSINA BEDS (MIDDLE TRIASSIC, MONTE SAN GIORGIO)

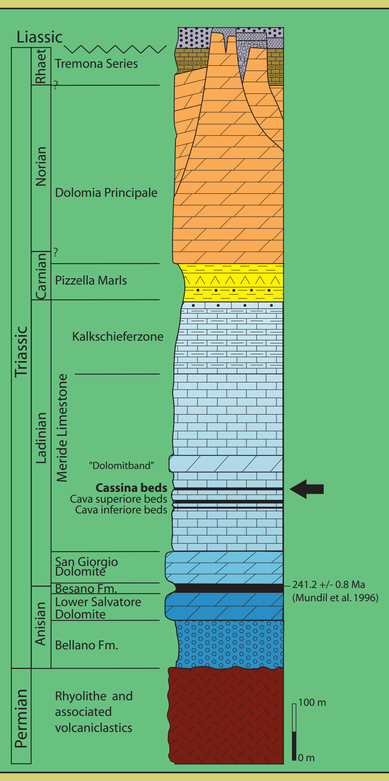
BACKGROUND AND EVENT SEDIMENTATION IN AN OXYGEN-DEPLETED ENVIRONMENT

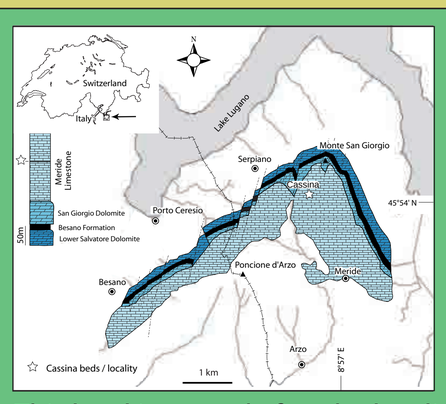
Rudolf Stockar [1,2]

[1] Museo cantonale di storia naturale, viale Cattaneo 4, 6900 Lugano, Switzerland.

[2] Université de Lausanne, Institut de Géologie et Paléontologie, Anthropole, 1015 Lausanne, Switzerland.

rudolf.stockar@ti.ch





The "Cassina beds" are a three metre thick sequence belonging to the five vertebrate fossil-bearing levels of the Middle Triassic Monte San Giorgio Lagerstätte (Canton Ticino, Southern Alps), inscribed in 2003 on the UNESCO World Heritage List because of its unique palaeontological value.

This level is named after the locality lying to the south of the Monte San Giorgio summit, where it was discovered in 1933 by the PIMUZ (University of Zurich), which carried out subsequent excavations in 1937, in 1971–73 and in 1975. All these excavations focused on vertebrates, and particularly on marine reptiles but also an exceptionally preserved fish fauna was brought to light.

In 2006, the Museo Cantonale di Storia Naturale (Lugano) started a new research project focusing on microfacies, micropalaeontological, palaeoecological and taphonomic analyses. So far, the upper third of the sequence has been excavated on a surface of around 40 m^2, and these new data supplement those derived from new vertebrate finds (mainly represented by over 300 fish specimens belonging to *Saurichthys*, *Archaeosemionotus*, *Eosemionotus* and *Peltopleurus*), allowing a better characterization of the basin. Palynological data available in the literature suggest an Early Longobardian (early Late Ladinian) age, but a revision is currently in progress.

LITHOFACIES

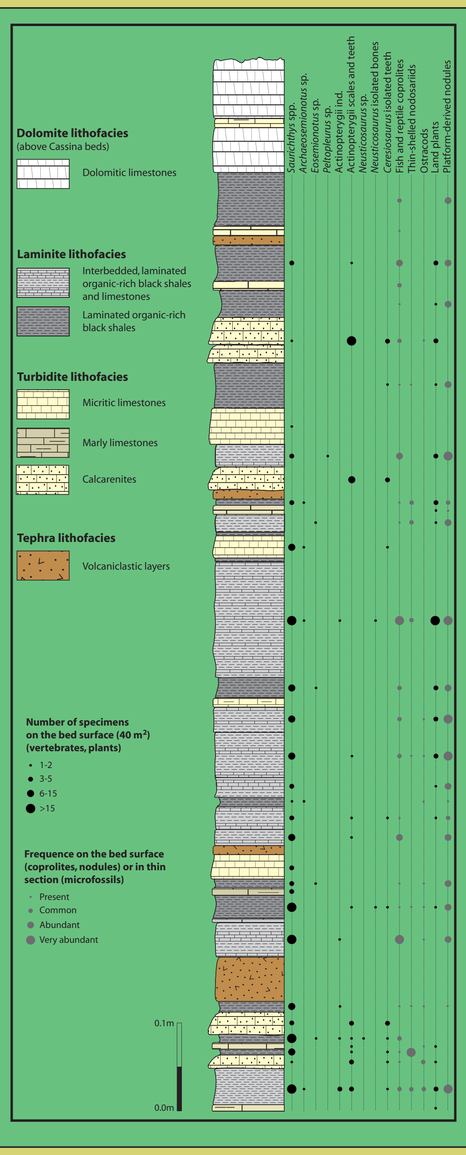
Three lithofacies groups are intercalated throughout the studied section.

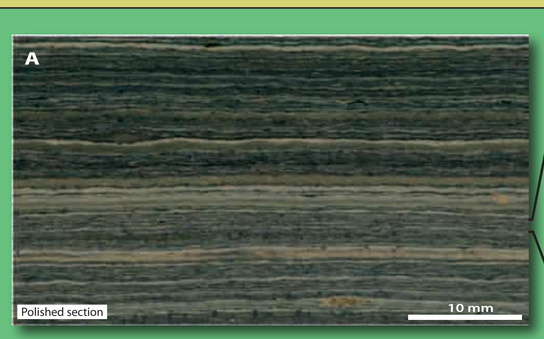
LAMINITE LITHOFACIES. Finely laminated organic-rich black shales and limestones constitute the main part of the section, and are characterized by a microrhythmic pattern of irregular, wavy dark and bright laminae, 30 to 300 micrometres in thickness. This lithofacies reflects the **background sedimentation** under severely oxygen-depleted conditions. In addition, it bears scattered carbonate nodules composed of reworked shallow-water biota (foraminifers and dasycladalean algae).

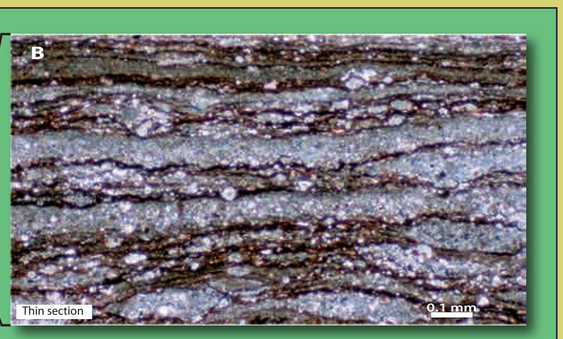
TEPHRA LITHOFACIES. Bentonite layers, derived from the alteration of volcanic ash and up to 5 cm thick, are easily detectable in outcrop since they weather to an orange colour. The absence of admixed carbonate allochemical constituents together with the widespread occurrence of very thin (sub-mm) layers suggest an airborne origin.

TURBIDITE LITHOFACIES. It includes calcarenites, micritic limestones and marly limestones, ranging in thickness from 1 mm to 4 cm, and records event deposition into the low-oxygen setting, mainly from dilute lime turbidity currents and detached lime mud-dominated turbidity currents due to water stratification.

The **DOLOMITE LITHOFACIES**, overlying the Cassina beds, is interpreted as a partly dolomitized counterpart of the turbidite lithofacies.







BACKGROUND SEDIMENTATION

Preservation of the fine lamination (Fig. A) suggests a complete absence of both bioturbation and physical reworking. The laminated fabric may derive from benthic microbial mats generating a framework resembling that of a supple tissue. Fine platform-derived detrital particles, carried into the basin as suspended load, could easily be trapped and fixed, contributing to the bright laminae (Fig. B).

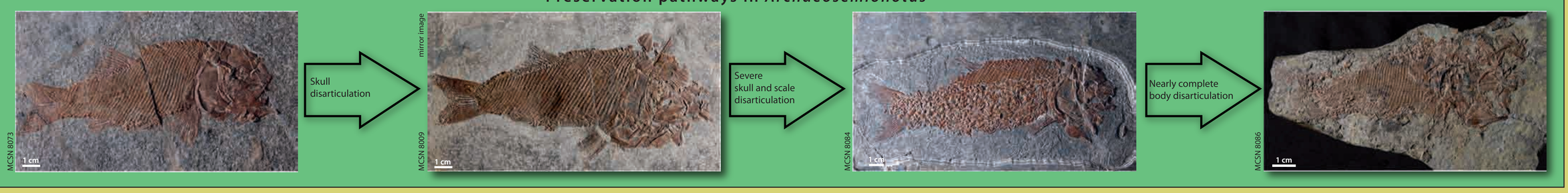
Systematic micropalaeontological analyses of the background sedimentation revealed the episodic occurrence of thin-shelled nodosariid foraminifers with elongate, randomly oriented, non-size-sorted tests (Figs. C-D). They are regarded as autochthonous, opportunistic biota, tolerant to low oxygen concentrations. Such a quasi-anaerobic (sensu Koutsoukos et al. 1990) monotypic benthic biofacies is documented for the first time from Monte San Giorgio.

PALAEO-OXYGENATION. The background sedimentation completely lacks of benthic and nektobenthic macrofauna, and thus it can be assigned to the ORB 1 (Wignall & Hallam 1991), indicating anoxia sensu latu. On a finer scale, the transiently occurring quasi-anaerobic biofacies suggests episodic suboxic bottom-water conditions (0.0–0.2 ml/l dissolved-oxygen range; Tyson & Pearson 1991). The upper limit of 0.2 ml/l is crucial because on the one hand it is the critical oxygen concentration below which macrofaunal bioturbation is suppressed, thus allowing the laminated fabric to be preserved, on the other hand it is still sufficient to sustain large populations of foraminifers with low oxygen requirements.

COMPARATIVE TAPHONOMY

Within the laminite lithofacies, fish fossils display different preservation patterns. Most of them are complete and preserved without, or with only partial, disarticulation. Even in the latter case, completeness of skeletons suggests that fish reached the sea bottom as complete bodies soon after death, and that all decaying processes occurred on the seafloor. As even anaerobic decay leads to disarticulation within short time, the prevailing articulated preservation may be due to the rapid growth of microbial mats and to the related bio-armouring of the carcasses ("microbial shroud" effect). Disarticulation pathways clearly vary between representatives of different species but also within the same species. *Archaeosemionotus* is characterized by a peculiar skull, composed of a complex mosaic of small bones, which makes it especially vulnerable to decaying processes, unlike the posterior part of the body, usually undisturbed. This genus proved particularly sensitive to biostratinomic processes and it is thus particularly suitable for comparative taphonomic analyses. Preliminary results show a transition from full skeletal articulation to partial and complete disarticulation. Ongoing investigations, requiring a large amount of fish specimens to be mechanically prepared and cross-correlations with sediment analyses on single lamina scale, are expected to provide information about the relationships between preservation pathways and environmental conditions on the seafloor.

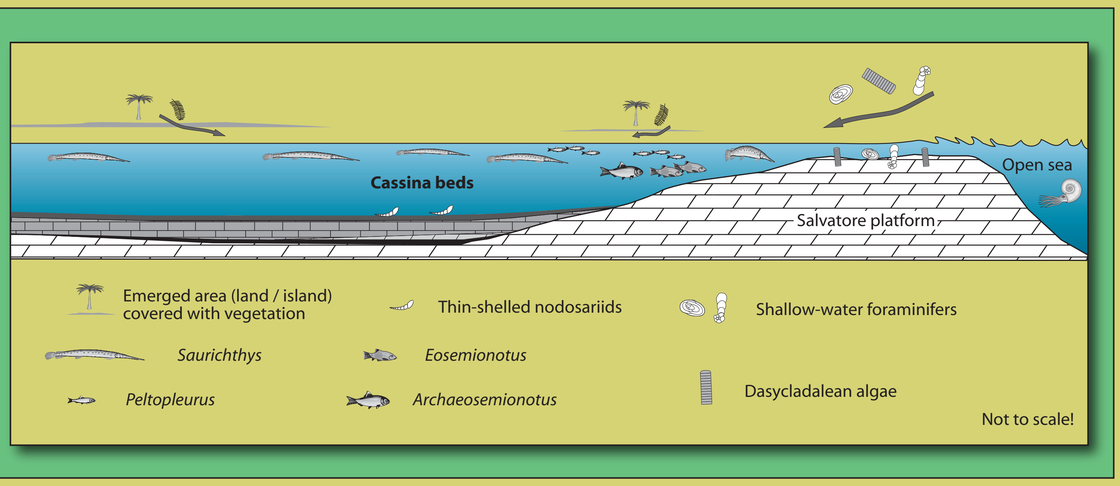
Preservation pathways in *Archaeosemionotus*



PRELIMINARY CONCLUSIONS

The studied section of the Cassina beds records a continuous background sedimentation (laminite lithofacies) mirroring fluctuating but generally severely oxygen-depleted conditions on the bottom of a basin below wave base and adjacent to a shallow-water carbonate platform from which a recurrent carbonate supply reached the basin floor, contributing to the sediment lamination.

Episodic, short-lived depositional events occur randomly and are related to feeding from basin margins (turbidite lithofacies) and to volcanic activity (tephra lithofacies). Fluctuating anoxic to temporarily suboxic conditions are suggested to have fostered the transient colonization of the seafloor by an extremely low-oxygen tolerant foraminiferal meiofauna. However, either oxygen values were too low or the sufficiently oxygenated periods were too short to allow colonization by a more diverse benthic macrofauna. Oxygen-deficient conditions are also consistent with the possible development of microbial mats which, in turn, may have contributed to protect the vertebrate carcasses against disintegration ("microbial shroud" effect).



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