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GEOCHEMISTRY OF ZOGNO NORIAN FOSSIL SITES

The famous fossil sites of Zogno (Zorzino Limestone) does not reveal a white (or light) "normal" plattenkalk, but a dark grey to black limestone to marly-limestone, usually more or less thinly laminated with a few massive beds.
The major fossiliferous level is at the boundary between the Riva di Solto Shale and the underlying Zorzino Limestone. Usually, a three-four meters thick level shows an irregular transition from the massive beds of the Zorzino Limestone to the black shales of the Riva di Solto Shale.
This is the level quarried at Endenna and Zogno2 sites, both in the Zogno area. However, in many other places all along the Lombardian Prealps, where this boundary level outcrops, well preserved fossils have been found. During this interval, paleoenvironment changed (Jadoul et al., 1994) and from a totally carbonatic environment the basins opened to an influx of clastic sediments. Strictly anoxic environment became established at the bottom of the central part of the basins themselves, allowing nice preservation of organic remains.
Probably, anoxia lasted for long time also after the shaly sedimentation became dominant: in fact in the lower part of the Riva di Solto Shale we have often another fossiliferous level (Sambusita, Ponte Giurino, etc.). Being lithology so uneven especially in the main level, calcareous versus more shaly limestone beds as well as thin to thick lamination, preservation of fossils can vary quite a lot. Early diagenesis was important, as we have evidence of very quick hardening of the sediments (Renesto et al., this volume). Late diagenesis also played an important role, as most of the bone microstructures has been destroyed.
Obviously the occurrence is more impure than other plattenkalks.
Samples were taken at the localities Zogno2, Endenna and Sambusita. The first two places are rather similar in facies, whereas Sambusita is much more marly, thinly bedded, and softer. Therefore are presented two sets of data : Sambusita on the one hand, Zogno2 and Endenna being combined on the other hand (in the figures under the name "Zogno").

A comparison with the geochemistries of normal plattenkalks, e.g. Cerin, Eichstätt, Canjuers, Pietraroja etc., is not reasonable, because of the eminent discrepancies in pureness. The only comparable sequence, analyzed in necessary detail up to now, is Montdardier; and also there the limestones are much purer, and only the intercalated marl beds of Montdardier reach an equivalent level.

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	ZOGNO2 + ENDENNA	SAMBUSITA	MONTDARDIER	
			limest.	marls
SIO2	10%	28%	2%	10%
TiO2	0,15	0,5	0,03	0,16
Al2O3	3	8	0,6	2,5
Fe2O3	1,5	7	0,2	0,8
MgO	4 (exc.dol.)	4	0,7	1 / 2,5
K2O	0,7	1,1	0,2	0,8
P2O5	0,12	0,16	0,005	0,014
S	0,28	0,36	0,1	0,05
Sr	900 ppm	500 ppm	450 ppm	320 ppm
Ba	70	140	25	65
Rb	20	60	10	25

Tab. 1.

Figs. 1 and 2 show that there is a lot of scattering around the average values of table 1.

In most cases the values of Zogno2 + Endenna fit in magnitude with the marls of Montdardier. However, there are some exceptions : Mg, P and S are distinctly lower in Montdardier marls than in Zogno. This fact could mean that marls intercalating limestones (Montdardier) are geochemically not identical with independent, whole marl sequences (Zogno, Sambusita).

Fig. 1, a comparison between Zogno2+Endenna with Sambusita and Cerin, shows the usual correlation lines (for Cerin rather close to the zero point, because of the pureness of Cerin resp. the marly characters of the two other sequences). The correlations exhibit their individual slopes.

A very characteristic feature of Zogno (and the related sequences) is, that not in nearly every 2-element-plot good correlations are developed, as it is usual in normal plattenkalks. Fig. 2 shows a triangle, randomly filled with scattered points. Similar patterns occur in Zogno2+Endenna in some diagrams with P, S versus Si and K, in Sambusita in diagrams with Fe, Ti, Mg and Sr.

Whereas the pattern of fig. 2 may be called a "positive" triangle, there exist "negative" triángles, too. Such patterns are developed in Zogno with Fe, Mg, Sr and others, in Sambusita with Mg, Sr, Ba, P and others.

The reason for these characteristic deviations from the normal plattenkalk behaviour may be that in the plattenkalks a dilution model is dominating, causing straight correlation lines. In Zogno2, Endenna and Sambusita, however, different independent sources (pyrite, organic phosphate etc.) may contribute, besides the detrital input, to the noncarbonate fraction; this causes positive or negative scattering fields.

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