

## AGE AND PALEOECOLOGY OF THE CONODONT *CLARKINA CHANGXINGENSIS* (WANG & WANG)

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With 5 figures

### Abstract:

*Clarkina changxingensis* was regarded originally as Upper Changxingian guideform. However, in western Sicily this species occurs already in the basal Dzhulfian (Wuchiapingian). It is always restricted to fully pelagic rocks. In shallow or restricted pelagic basins it is replaced by other gondolellid conodonts, such as *Clarkina leveni* (KOZUR, MOSTLER & PJATAKOVA), *C. orientalis* (BARSKOV & KOROLEVA) or *C. subcarinata* (SWEET) which are rare or missing in deep pelagic rocks deposited at the margin of the world ocean.

The new subspecies *C. changxingensis italica* n. subsp. is described.

### Zusammenfassung:

*Clarkina changxingensis* wurde ursprünglich als Leitform des Oberchangxingian angesehen. In West-Sizilien kommt diese Art jedoch bereits im basalen Dzhulfian (Wuchiapingian) vor. Sie ist nur in vollpelagischen Ablagerungen anzutreffen. In flachen oder abschnürten Becken wird *C. changxingensis* durch andere Gondolellen ersetzt, wie z.B. *Clarkina leveni* (KOZUR, MOSTLER & PJATAKOVA), *C. orientalis* (BARSKOV & KOROLEVA) oder *C. subcarinata* (SWEET), die in tief-pelagischen Ablagerungen am Rande des Weltozeans selten sind oder fehlen.

Die neue Unterart *C. changxingensis italica* n. subsp. wird beschrieben.

*Clarkina changxingensis* (WANG & WANG) has been regarded for long time as guideform for the Upper Changxingian (WANG & WANG, 1979, ZHAO et al., 1991, KOZUR, 1989 a, c). In most of the South China sections, this species begins not earlier than in the Upper Changxingian. However, in these sections no forerunner of *C. changxingensis* is known from the underlying beds and the first appearance of *C. changxingensis* is connected with a general deepening of the basin: Paralic sections became shallow-marine and in shallow-marine sequences a deepening can be observed. *C. changxingensis* and several other pelagic faunal elements (e.g. radiolarians) immigrated at the base of the Upper Changxingian into the Permian sea of South China. The first appearance of *C. changxingensis* in the Upper Changxingian of South China is therefore facies-controlled.

In western Sicily a pelagic deep-water sequence from the Leonardian up to the Changxingian (and further up to the Miocene) is present (CATALANO, DI STEFANO & KOZUR, 1988, in press; localities and stratigraphic data see these papers). In the Changxingian part of the deep-pelagic red clays of the Torrente San Calogero section *C. changxingensis* is often the only gondolellid

conodont, but conodonts are rare in this facies. A lot of *C. changxingensis* and *Clarkina* n. sp. are present in thin calcarenites intercalated in the red clays. Only in one of these calcarenites single specimens of the Changxingian index species *C. subcarinata* are present. Gondolellids of the *C. bitteri* - *C. leveni* - *C. orientalis* line are absent.

In thick Changxingian calcarenites of another section (south of Pietra die Saracini) species of the *C. bitteri* - *C. orientalis* lineage are present, *C. subcarinata* is dominant and *C. changxingensis* is represented by robust forms. These calcarenites contain among the siliceous sponge spicules both pelagic and shallow-water forms.

Conodonts are mostly very rare in the Lower Dzhulfian deep-water red clays of the Torrente San Calogero section. Most of gondolellid conodonts belong to a new *Clarkina* species that will be described in a paper by GULLO & KOZUR (in press) as *Clarkina sosioensis*. *Clarkina changxingensis* is present as well. In a rather thick calcarenite intercalated in the Lower Dzhulfian red clays both *C. changxingensis* and *C. sosioensis* are very abundant. *C. changxingensis* is represented by very few typical specimens (*C. changxingensis changxingensis*) and by a lot of primitive representatives (*C. changxingensis italica*

n. subsp.). The red clays contain abundant radiolarians. The sponge spicules both of the red clays (rather rare) and of the calcarenites (mass occurrences) consist exclusively of deep-water associations. Also the mass occurrence of Albalicellacea (radiolarians) and of paleopsychrospheric ostracods indicate open-sea deep-water environment.

According to the previous view about the range of *C. changxingensis*, this above conodont fauna with *C. changxingensis* and *C. sosioensis* should be of Late Changxingian age. However, the radiolarian fauna indicates an Early Dzhulfian age. This contradiction can be only solved by reconsideration of the facies dependence of the gondolellid conodonts. All gondolellids have been regarded as pelagic conodonts. However, some gondolellids are characteristic of shallow-pelagic of restricted basin environments, e.g. the *Clarkina bitteri*-*C. leveni*-*C. orientalis* lineage, the *Scythogondolella milleri* group, the *Neogondolella mombergensis*-*Celsigondolella watznaueri* lineage. These forms are missing or rare in deep-pelagic open-sea environments. Other gondolellids, like *C. sosioensis* are typical deep-water conodonts, missing in shallow pelagic environments. *C. changxingensis* is missing in shallow-water deposits, present in shallow-pelagic and dominant in deep-pelagic environments. Therefore this species invaded the South Chinese Late Permian sea only in the Upper Changxingian along with radiolarians and other pelagic faunal elements.

The phylomorphogenetic lineage *Clarkina bitteri*-*C. liangshanensis*-*C. orientalis* n. subsp.-*C. orientalis orientalis* is well documented. In contrast, the forerunner of *C. changxingensis* was unknown until now. The primitive forms of *C. changxingensis* (*C. changxingensis italica*) from the Lower Dzhulfian clearly indicate a derivation from *Mesogondolella* cf. *babcocki* (CLARK & BEHNKEN) which is identical in platform outline and carina, but displays a serration of the platform margin in the anterior third to half of the platform. The holotype of *M. babcocki* is a typical *M. postserrata*. However, other specimens of *M. babcocki* belong to an independent species. It is characterized by a pointed, narrowly rounded or obliquely pointed posterior end of the platform, in which the transition in the lateral platform margin is gradual. In *M. postserrata* (and in the holotype of *M. babcocki*) the change from the posterior margin to the lateral margins is at least on one side abrupt. *Mesogondolella* cf. *babcocki* is therefore a new advanced species of the *M. postserrata* group that will be described after re-studies of the *Mesogondolella* complex from the Lamar Limestone (West Texas).

No separation of Lower and Upper Changxingian conodont faunas is possible after these results. The immigration of *C. changxingensis changxingensis* in the Upper Changxingian of South China is a facial event (deepening of the basin). By the same reason, *Hindeodus julfensis* (SWEET) disappeared. However, in the regressive transitional beds *H. julfensis* re-appears. Therefore the real range of *H. julfensis* is (Upper) Dzhulfian to topmost Changxingian, and *C. changxingensis* is present in suitable facies from the Lower Wuchiapingian to the topmost Changxingian. *C. subcarinata*, the guideform of the Changxingian is present from the basal up to the topmost Changxingian. A first appearance in the Upper Dzhulfian cannot be excluded.

Typical *C. changxingensis changxingensis* are already present in the Lower Dzhulfian, but rare. Here forms with very narrowly rounded to pointed or obliquely pointed posterior platform end are dominant. For these forms a new subspecies, *C. changxingensis italica* n. subsp. is introduced that will be described below.

#### Genus *Clarkina* KOZUR, 1979

**Type species:** *Gondolella leveni* KOZUR, MOSTLER & PJATAKOVA, 1976

*Clarkina changxingensis italica* n. subsp.

(Figs. 1–4)

**Derivatio nominis:** Based on occurrence in the Dzhulfian of western Sicily, Italy

**Holotype:** The specimen on fig. 1; rep.-no. CK 121290/I-32.

**Type locality:** Torrente San Calogero section, Sosio Valley area, western Sicily (see CATALANO et al., 1988, in press)

**Type stratum:** Lowermost calcarenite within the Lower Dzhulfian to Changxingian red deep-water clays. Lower Dzhulfian.

**Material:** More than 100 specimens.

**Diagnosis:** Platform moderately broad, widest at the beginning of its posterior third. Posterior end narrowly rounded to pointed, mostly with an indistinct to distinct buttress that is not set off by distinct notches. In many specimens the platform end is a little to strongly asymmetrical and then obliquely pointed. Lateral platform margin broad, flat, slightly to moderately upturned, with gradual transitions in the posterior margin. Carina in adult forms with 12–16, commonly 13–15, laterally compressed denticles that are in the anterior part of the carina moderately high, in its middle and posterior part low and strongly fused. Carina extends to the posterior margin, but around

the posterior denticle a narrow platform brim is in most specimens present. Cusp missing to small. In juvenile forms the cusp may be distinct.

Platform surface without serration, but indistinct undulations on the whole surface may be present.

Keel on the lower surface broad, flat, striated, not depressed in its middle part. Subterminal basal cavity with elevated margins.

**Occurrence:** Frequent in the Lower Dzhulfian of Sicily, rare in the Dzhulfian of Transcaucasia. Frequent Rare in the Changxingian of Sicily.

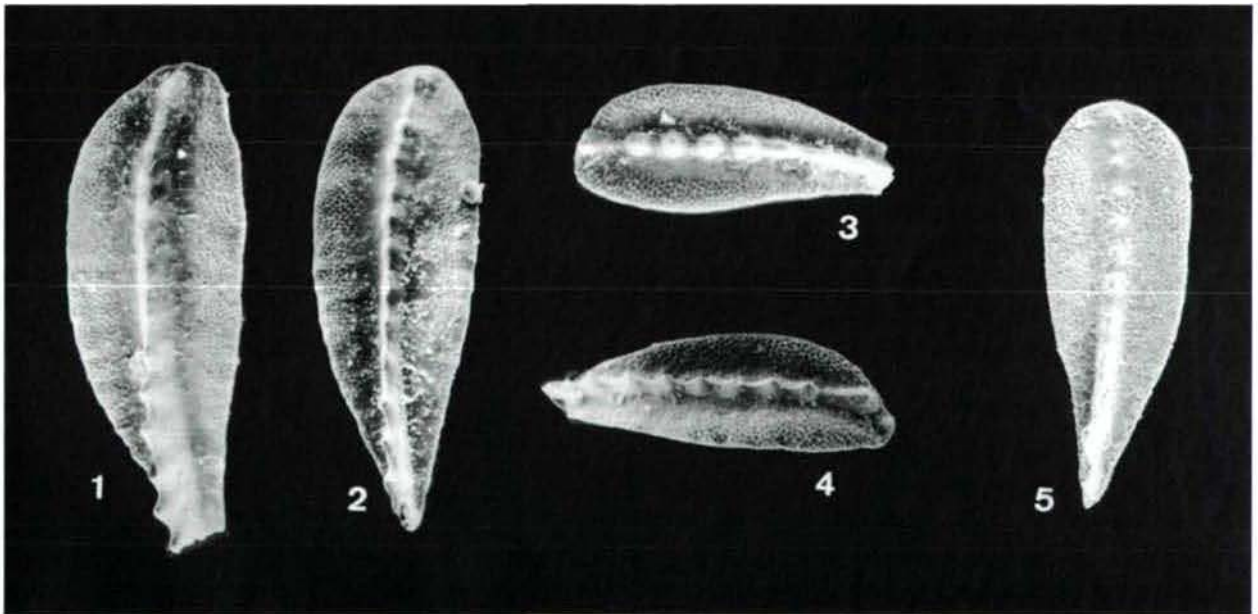
**Remarks:** *C. changxingensis changxingensis* (WANG & WANG) is distinguished by a more rounded, always symmetrical posterior end; a buttress is never present. All transitions between the two subspecies are present.

As discussed above, *C. changxingensis italica* n. subsp. has evolved from *Mesogondolella* cf. *babcocki* (CLARK & BEHNKEN). However, transitional forms are unknown from Sicily, because in these fully pelagic beds conodonts of the *Mesogondolella postserrata* group are almost missing and the conodont content is concentrated to the few calcarenites within the red deep-water clays.

*M.* cf. *babcocki* is only distinguished by the serration of the anterior third to half of the platform margin.

The assumed change from *Mesogondolella* cf. *babcocki* to *Clarkina changxingensis italica* could be an important datum for the definition of the Middle-Upper Permian boundary. For solving of this problem, the conodont faunas of the uppermost Maokou- and lower Wuchiaping Formation of South China, from the Abadehian of Central Iran and from the post-Lamar/pre-Castile beds of the Guadalupe Mts. in West Texas have to be re-investigated.

The transition between the Lower/Middle Permian genus *Mesogondolella* and the Upper Permian/Lower Triassic genus *Clarkina* occurred in different lineages. The *M.* cf. *babcocki* - *C. changxingensis italica* - *C. changxingensis changxingensis* lineage (to which belongs also *C. sostoensis* GULLO & KOZUR, in press, as side-branch) represents a similar lineage as the *M. behnkeni* - *C. rosenkranzi* lineage (derivation from *Mesogondolella* with platform serration), whereas the *C. bitteri* - *C. liangshanensis* - *C. leveni* - *C. orientalis* lineage evolved perhaps from unserrated *Mesogondolella*.



**Figs. 1-4:** *Clarkina changxingensis italica* n. subsp., fig. 1: holotype, Dzhulfian calcarenite in the lowermost part of the Dzhulfian to basal Changxingian Red Clay Unit, Torrente San Calogero section, x 50, rep.-no. 121290/I-32; fig. 2: Changxingian calcarenite section south of Pietradi Saracini, x 50, rep.-no. 121290/I-35; fig. 3: juvenile specimen, age and locality as for fig. 1, x 100, rep.-no. 589/I-21; fig. 4: juvenile specimen, basal Changxingian calcarenite in the Red Clay unit, Torrente San Calogero section, x 100, rep.-no. 589/I-2.

**Fig. 5:** *Clarkina changxingensis changxingensis* (WANG & WANG), Changxingian calcarenite, outcrop south of Pietra di Saracini, x 80, rep.-no. 121191/IX-4.

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