New Aspects on Tethyan Cretaceous Fossil Assemblages.
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1.1. Tethys – the evolution of an idea

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Abstract

Tethys in its original meaning was understood by Eduard SUESS as the ancient sea separating Angaraland from Gondwanaland. Contrasting to this paleogeographic conception, "Tethys" and "Tethyan" are currently used with different meanings in tectonics and paleo-biogeography. In paleobiogeography, Tethys is understood as a realm with varying extension. This dynamic conception is in contrast to the conception of the stable Cretaceous Mesogée by DOUVILLÉ (1900).

Introduction

The terms Tethys and Tethyan were introduced to science by Eduard SUESS (1893). Since this time not only the meaning of these terms has changed considerably. To make the confusion perfect they are also used in various ways in Earth Sciences. It is therefore of interest to compare the different meanings of Tethys and Tethyan in modern literature. Completeness has not been attempted in this account. The aim is a general outline of how these terms have evolved.

In an address to the Geological Society of London, E. SUESS, (1893) stated: "Modern geology permits us to follow the first outlines of the history of a great ocean which once stretched across part of Eurasia. The folded and crumpled deposits of this ocean stand forth to heaven in Tibet, Himalaya, and the Alps. This ocean we designate by the name Tethys, after the sister and consort of Oceanus." This name was accepted in science immediately. As BITTNER (1896) remarked sarcastically it was also mis-spelled as Thetis by authors from the beginning and therefore confused with the mother of Achilles. The tran-

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scriptions into the latin alphabet are very similar, indee, but there is no way of confusion in the original Greek.

In the third volume of his synthesis on the geology of the earth, "The Face of the Earth", Eduard SUESS, (1901), gave a more detailed description of this ocean: "Gondwanaland is bound to the north by a broad zone of marine sediments of Mesozoic age: From Sumatra and Timor over Tonking, Yunan, the Himalaya and Pamir, the Hindukush into Smaller Asia. As a whole they have to be considered as the remains of a sea which extended through Asia." Later in the same book, SUESS decribes the prolongation of this hypothetical sea into Mexico and the Caribbean. The land north of Tethys was named by him Angaraland.

Actually, Eduard SUESS was not the first to draw attention to the existence of this former sea. It had already been deduced by NEUMAYR (1887) from the distribution of Mesozoic marine sediments. The later Tethys had been named by NEUMAYR Central Mediterranean (Zentrales Mittelmeer). He had already come to the conclusion that this sea was not very broad and extended from West to East between Central America and India.

This original conception of the Tethys by NEUMAYR and SUESS was therefore an exclusively paleogeographic one. It was understood in this sense by UHLIG (1911), DIENER (1925), and DAQUÉ (1926). This was also pointed out by NAIDIN (1986) in his account on the term Tethys and by YENKINS (1980). RAKUS, DERCOURT & NAIRN (1990) have discussed the northern margin of the Tethys in a paleogeographic conception but in the light of plate tectonics.

Tethys as a tectonic concept

This is based primarily on HAUG's (1900) interpretation of the concept of geosynclines of HALL (1859) and DANA (1875). In the sense of Hall a geosyncline (the original term geosynclinal was created by DANA) is an extraordinary accumulation of sediments of shallow water origin. HAUG (1900), restricted the geosynclines to depressional zones of great depth between continental masses where thick series of deep-water sediments were deposited.

In HAUG's figure a geosynclinal area is situated between an Afro-Brasilean continent and a North Atlantic continent. It was considered by STAUB (1924) as the central zone of the Tethys ocean of E. SUESS. According to STAUB this ocean covered broad areas of the adjoining continental masses. Opposed to the designation in the text the name Tethys was applied exclusively to the oceanic area in the table on the evolution of the alpine system. In 1928, STAUB states that two types of mountain chains may be distinguished in the Alpine orogenetic zone. One of them stems from a broad marine basin. STAUB says: "This is the so-called Tethys by SUESS." He further points out that ophiolites generally occur together with deep-water sediments in the sections.

Although this interpretation of the Tethys does not agree with the original concept of Eduard SUESS it has found entrance in virtually all synthetic

work on the plate tectonics of the Mediterranean area. Based on STAUB's work, Tethys is considered as an oceanic plate by SMITH (1971), DEWEY, PITMAN, RYAN & BONNIN (1973), LAUBSCHER & BERNOULLI (1973), BIJU-DUVAL, DERCOURT & PICHON (1977), and others.

Temperature-controlled realms

In 1883 NEUMAYR had established a latitudinal zonation of the Jurassic and the lower Cretaceous which was based on marine faunas, mainly ammonites. He related the paleobiologically defined zones to temperature-controlled realms. After NEUMAYR, the following realms can be distinguished:

1. The tropical equatorial realm with *Phylloceras, Lytoceras,* and *Simoceras;*
2. the (north) temperate realm with *Oppelia* and *Peltoceras;*
3. the boreal realm with Aucellids and the "group of *Belemnites excentricus*". *Oppelia* and *Aspidoceras* are rare in this realm; *Phylloceras, Lytoceras* and *Simoceras* are missing as are reef corals;
4. the south temperate realm.

Only five years later GUEMBEL (1888) published a lateral zonation for the Upper Cretaceous. He distinguished the following provinces in Europe:

1. The North province characterized by *Belemnitella;*
2. the Hercynic province with *Exogyra columba;*
3. the Moscow province with "*Aucella*";
4. the province characterized by abundant rudists. GUEMBEL gives the following distribution of this province (translated from the German): Alps, Italy, Greece, Crimea, Caucasus, Asia Minor, Palestine, through Persia to the Persian Gulf. He further includes the Cretaceous of Africa beginning with Egypt through the Libyan desert and the whole of North Africa.

This zonation of GUEMBEL (1888) was already quoted by NEUMAYR (1887) who distinguished for the Upper Cretaceous two temperature-controlled realms: A temperate realm with Belemnitella and the equatorial realm with rudists, Actaeonella, Nerinea and Lytoceras. He was followed by UHLIG (1911), who pointed out that like modern coral reefs the Cretaceous coral and rudist reefs were developed in the Tropical belt which was much broader then. The same was emphasized by DIENER (1925), and DACQUÉ (1926).

The Mésogée

All authors mentioned above have strictly kept apart the paleogeographic concept of Tethys in the sense of Suess from the temperature-controlled realms deduced from the distribution of fossils. This is different in the concept of the Mésogée by H. DOUVILLÉ (1900), who defined it as follows: «La Mésogée correspond à une phase particulière de la Méditerranée centrale de NEUMAYR ou de

la Tethys de SUESS: c'est uniquement la mer dans laquelle les Rudists ont vecu et se sont developpés.» In addition to rudists, DOUVILLÉ listed a number of other fossil groups resticted in his opinion to the Mésogée. These include especially orbitoids and orbitolinids among the larger foraminifera, a number of ammonite families and genera as well as the echinoid *Entallaster*.

The Mésogée although a linguistic monstrosity (GIGNOUX, 1950, has pointed out that Mésogée means continent in the middle which is just the opposite of what DOUVILLÉ wanted to say) is therefore basically a paleo-biogeographic concept. DOUVILLÉ demonstrated that in the Cretaceous a number of fossil groups is restricted to the Tethys in the sense of NEUMAYR and SUESS. This concept has been referred to outside of France by DIENER (1925).

Generally, Cretaceous faunas of low latitudes were called Mediterranean by SCHUCHERT (1910), KOSSMAT (1936) and SCHUCHERT (1935). It was SCHUCHERT who obviously first used the term Tethyan realm in the same work. Tethyan is herewith first employed for the low latitude belt defined with fossil assemblages by NEUMAYR, GUEMBEL, DOUVILLÉ and others. This application does definitely not agree with the original meaning of this term. Nevertheless, it is widely used in this sense, as a biologically defined circumequatoreal belt by paleontologists among them AGER (1967), DONOVAN (1967), SOHL (1971, 1987), KAUFFMAN (1973), BERGGREN & HOLLISTER (1974), KENNEDY & COBBAN (1976) and others. Supertethys, a central belt within the Tethyan realm proposed by KAUFFMAN & JOHNSON (1988) will be discussed by KOLLMANN (this volume).

Tethys or Mésogée

The Mésogée concept is undoubtedly very useful when applied to Cretaceous shallow marine environments. Nevertheless it cannot be upheld in its original context as its distribution does not correspond to the Cretaceous Tethys of NEUMAYR and SUESS as DOUVILLÉ thought.

While DOUVILLE's Mésogée is the total area of distribution of rudists throughout the Cretaceous, the concept of the Tethyan realm as it is used now by many paleontologists is a dynamic one taking into account the fluctuation of realm boundaries during geologic times. The differences in the distribution of Lower Aptian and Campanian to Maastrichtian rudists have been shown by MASSE (1985) and PHILIP (1985).

It is therefore difficult to decide, which term to use: Mésogée, which can't be upheld in its original static conception but has the advantage of having an uncompromised name. Or Tethys as a dynamic paleo-biogeographic concept which is acceptable from a scientific point of view but does not agree with the original content of this term. Which term to use is not so much a matter of philosophy but of convention. IGCP Project 262 was named Tethyan Cretaceous Correlation because Tethyan is used all over the world in a paleo-biogeographic sense and did not need much of an explanation. But nothing should be

static in geology and therefore J. P. MASSE's support of Mésogée is of great importance for further discussions.

Another premise of the project is that accepting a boundary deduced exclusively from a single shallow water fossil group such as rudists is too limiting for further work. It will be necessary to achieve a broader understanding of this realm by collecting and interpreting data on as many fossil groups as possible. The concept of the Tethyan realm must be kept open for discussion in order to improve our knowledge of Cretaceous paleo-biogeography.

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