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First occurrence of temnospondyls from the Permian and Triassic of Turkey: Paleoenvironmental and paleobiogeographic implications

Premiers temnospondyles du Permien et du Trias de Turquie : implications paléoenvironnementales et paléobiogéographiques

Josep Fortuny[a,*], J.-Sébastien Steyer[b], Izzet Hoşgör[c]

[a] *Institut Català de Paleontologia Miquel Crusafont, Universitat Autònoma de Barcelona, Edifici ICTA-ICP, Carrer de les Columnes s/n, Campus de la UAB, 08193 Cerdanyola del Vallés, Barcelona, Spain*
[b] *CR2P, UMR 7207 CNRS-MNHN-UPMC, Muséum national d'Histoire naturelle, 8, rue Buffon, CP38, 75005, Paris, France*
[c] *Çalık Energy, Ak Plaza, Yaşam Caddesi n° 7 – Kat 9, Sögütözü-Ankara, Turkey*

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ABSTRACT

Permian and Triassic tetrapods are very rare in Turkey. Yet this group bears important paleoenvironmental and paleogeographical signals to better understand Pangean models, and especially the geodynamic history of the Permian and Triassic in Turkey, which remains highly debated. Here we present and describe the first temnospondyls from Turkey (SE Anatolia) which consist of a Middle Permian branchiosaurid and an Early Triassic stereospondyl. The branchiosaurid is the first representative of its group in Gondwana and the first from the Middle Permian: it therefore brings important paleogeographic implications and supports the hypothesis that anamniotic tetrapods may have used trans-Pangean migration routes between Europe and Gondwana. It also brings new data to the debated depositional environment of the Permian of SE Anatolia. The Triassic stereospondyl represents one of the few tetrapods known from paleoequatorial areas and confirms a relatively rapid faunal turnover of the anamniotic fauna after the Permian-Triassic mass extinction.

Mots clés :
Permien moyen
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Branchiosauridae
Stereopondyli
Migrations pangéennes

RÉSUMÉ

Les tétrapodes du Permien et/ou du Trias sont très rares en Turquie. Cependant, il a été montré que ce groupe est porteur d'un signal paléoenvironnemental et paléogéographique important, aidant à mieux comprendre les modèles de Pangée, et plus particulièrement l'histoire géodynamique de la Turquie qui demeure très débattue au cours du Permien et du Trias. Nous présentons et décrivons ici les premiers temnospondyles découverts en Turquie (SE d'Anatolie) ; un branchiosauridé du Permien moyen et un stéréospondyle du Trias inférieur. Le branchiosaure à lui seul est le premier représentant du groupe au Gondwana, et le premier datant du Permien moyen : il apporte donc des informations paléogéographiques importantes et confirme que les tétrapodes anamniotiques auraient emprunté des voies de migration trans-pangéennes entre l'Europe et le Gondwana. Il apporte également des

* Corresponding author.
E-mail address: josep.fortuny@icp.cat (J. Fortuny).

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données nouvelles concernant l'environnement de dépôt du Permien du Sud-Est d'Anatolie. Le stéréospondyle du Trias, quant à lui, représente un des rares tétrapodes connus dans la zone paléoéquatoriale de l'époque et confirme que le renouvellement faunique des tétrapodes anamniotiques s'est effectué assez rapidement après la grande crise Permien-Trias.

1. Introduction

Permian and Triassic rocks from Turkey remain virtually unexplored by vertebrate paleontologists. The Permian and Triassic tetrapod remains known from Turkey consist only of Permian tetrapod footprints from the North of the country (Gand et al., 2011) and Triassic phytosaurian, lungfish and chondrichthyan teeth from the South (Buffetaut et al., 1988; Monod et al., 1983; Thies, 1982). Yet the Permian and Triassic Systems are key for understanding the highly debated geodynamic history of the country: during the Permian and Triassic, according to various models, Turkey consists either of two plates widely separated by the Paleotethys Ocean – one plate belonging to Euramerica and the other to Gondwana (according to Scotese, 2001, Ziegler, 2001, and Ziegler et al., 1997), or of a single assemblage, possibly an isthmus, more or less isolated in the Paleotethys Ocean (Heckert and Lucas, 1999). Moreover, the depositional paleoenvironments of Turkish geological formations are still much debated: for example, the Permian of SE Turkey is considered to represent either marine or freshwater paleoenvironments (e.g., Bozdoğan and Ertug, 1997; Fontaine, 1981).

Here we report and describe new tetrapod remains from the Permian and Triassic of southeastern Anatolia (Fig. 1): although fragmentary, these fossils represent the first occurrences of temnospondyls in the country and are important to better understand the complex tectonic history of Turkey as well as its paleoenvironmental evolution during the Paleozoic-Mesozoic transition. These fossils also clearly show the potential of Turkey in terms of vertebrate paleontology, paleoenvironments and paleobiogeography.

2. Material and geological setting

The specimens were collected in 2009 and 2010 by IH in the Hazro area, southeastern Anatolia, during detailed stratigraphical fieldwork in the Paleozoic-Mesozoic local successions (Denayer and Hoşgör, 2014; Gourvennec and Hoşgör, 2012; Hoşgör and Kostak, 2012; Hoşgör and Stamberg, 2014; Hoşgör et al., 2012). The fossil remains are stored in the IPS (Institut Català de Paleontologia Miquel Crusafont of Sabadell, Spain) collections and consist of two temnospondyl remains coming from two different stratigraphic levels of different estimated ages:

- an almost complete but weathered branchiosaurid skeleton from the Middle Permian Kaş Formation of the Tanin Group (IPS-83195, Fig. 2);
- a large skull roof bone, possibly a postparietal, of a large stereospondyl (IPS-83862, Fig. 3) from the Early Triassic Uludere Formation of the Çığlı Group.

Both remains were recovered from southeastern Anatolia. The rocks of this area belong to two major tectonic units:

- the autochthonous units that include Palaeozoic and Mesozoic sequences belonging to the Arabian Plate;
- the allochthonous units that include Late Cretaceous and Paleogene sequences belonging to the Anatolian Plate and the Bitlis-Zagros suture zone.

The fossils described here come from the autochthonous units. The autochthonous sequences of the foreland area, the folded belt and of the foothill structure belt form the so-called "Border Fold Zone" (Fontaine et al., 1980) located approximately 75 km northeast of the city of Diyarbakır (Fig. 1). This zone is characterized by an 80 km long WNW-ESE trending anticline, rising up at the southern edge of the foothill structure belt (Kellog, 1960; Lebkuchner, 1976; Tolun, 1951). The main autochthonous lithostratigraphic units are briefly reviewed here to provide a framework for the later lithofacies and paleoenvironmental discussion (see also Tolun, 1960; Yılmaz and Duran, 1997 for details): the Late Paleozoic (Permian) and Early Mesozoic (Triassic-Early Jurassic) successions in southeastern Anatolia consist of 13 formations forming three groups; namely the Tanin Group (Middle-Late Permian), the Çığlı Group (Early Triassic) and the Cudi Group (Middle Triassic to Early Jurassic), containing carbonated, clastics and evaporitic rocks of economic importance because they host hydrocarbon reservoirs (Altınlı, 1954; Kellog, 1960; Perinçek, 1990; Schmidt, 1964; Yılmaz and Duran, 1997). The Permian and Triassic rocks from the Hazro area, which yielded the fossils, are:

- the Permian deposits, which rest unconformably on the Carboniferous, belong to the Tanin Group (Perinçek, 1990). This group is subdivided into the Kaş and Gomaniibrik formations. The latter was previously dated to the Tatarian (Late Permian) according to palynomorph and foraminiferous assemblages (Bozdoğan et al., 1987; Köylüoğlu and Altiner, 1989), but recent investigations show that the Gomaniibrik Formation comprises three lithological members (carbonates at the bottom and top members, siltstones and sandstones with a few coal layers at the middle member, see Gümüş et al., 1992; Schmidt, 1964; Yılmaz and Duran, 1997), which recorded