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New marine reptile assemblage from the Jurassic-Cretaceous boundary beds of the High Andes, Argentina

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Jurassic marine reptiles from the southern margin of the Eastern Pacific have been documented since the XIX century. Most of them have been recorded at the Neuquén Basin (west-central Argentina) in sedimentary rocks of the Vaca Muerta Formation (lower Tithonian-lower Valanginian). Outcrops of this lithographic unit in the southern sector of the basin have proven to be highly fossiliferous in marine reptiles (*e.g.* Cerro Lotena, Los Catutos and Pampa Tril, in the Neuquén Province; Gasparini and Dellapé, 1976; Pol and Gasparini, 2009; Gasparini and Fernández, 2011; Herrera *et al.*, 2013). By contrast, exposures of the Vaca Muerta Formation in the northern sector of the Neuquén basin (Mendoza Province), though widely distributed, had not been prospected for marine reptiles since the middle of the XX century (*e.g.* Rusconi, 1938, 1948a, b, 1967).

During the last two years, a new field survey for marine reptiles was carried out in the southern Mendoza sector of the Neuquén Basin. Two cross-sections, 14 km apart, of the Vaca Muerta Formation were performed over the eastern flank of a NW-SE syncline: Arroyo Durazno (*c.* 260 m), located over the left margin of the El Durazno Creek, to the south, and Arroyo Paulino (*c.* 220 m), outcropping on the right margin of the Paulino Creek, to the north. At both localities the Vaca Muerta Formation consists of an intercalation of organic-rich laminated marls and nodular to massive limestones. Over the basis of bed-by-bed ammonoid sampling, an early to middle early Tithonian-early to middle Berriasian age span was determined for the succession studied at Arroyo Durazno (*Virgatosphinctes andesensis* to *Argentiniceras noduliferum* Andean Assemblage Zones; *Darwini/ Semiforme* to *Occitanica* Zones). While a late Tithonian-early to middle Berriasian age span was proposed for the interval analyzed at Arroyo Paulino (*Windhausenicerias internispinosum* to *A. noduliferum* Andean Assemblage Zones; *Microcanthum* to *Occitanica* Zones). In consequence, marine reptiles were sampled in connection with an accurate ammonoid based biostratigraphic control at both sections.

At Arroyo Durazno, 18 *in situ* marine reptiles were identified (14 ichthyosaurs, four metriorhynchid crocodylomorphs, and one eucryptodira turtle) and also four *ex situ* ichthyosaurs and five *ex situ* metriorhynchids coming from the same unit. Whilst at Arroyo Paulino, four *in*

situ ichthyosaurus and five metriorhynchids have been found, plus one *ex situ* metriorhynchid. At both sections, marine reptile findings are concentrated in beds assigned to the *Corongoceras alternans* Zone, late Tithonian; *Microcanthum* to *Durangites* Zones).

Preliminary results depict ichthyosaurs as the main component of fossil assemblages (N= 22). Most of them are represented by articulated vertebrae. However, at least three specimens, based on forefin and pelvic morphologies, can be certainly identified as ophthalmosaurids. Metriorhynchids are also abundant (N= 15) and, contrary to ichthyosaur materials, most of them are diagnostic to a subfamily level. Six of them are provisionally referred to Metriorhynchinae indet. and four to Geosaurinae indet. Although both subfamilies have been previously identified at different localities of the Neuquén Province (e.g. Gasparini and Dellapé, 1976; Pol and Gasparini, 2009; Herrera *et al.*, 2013; Herrera and Vennari, 2015), this is the first report of geosaurines and metriorhynchines recorded together at the same locality and within the same ammonite zone (*Corongoceras alternans* Zone). Of particular interest is one specimen of metriorhynchine, recovered from beds assigned to the *Argentiniceras noduliferum* Zone at Arroyo Paulino and identified as cf. *Cricosaurus*. This finding represents the first unquestionable record of an early cretaceous Metriorhynchinae from the Neuquén Basin. In addition, the only other tetrapod recorded at the studied sections, consists of a single eucryptodiran turtle identified as cf. *Neusticemys neuquina* (de la Fuente *et al.*, 2016) from a bed included in the upper Tithonian-lower Berriasian *Substeueroceras koeneni* Zone (*Durangites* to *Jacobi* Zones) at Arroyo Durazno.

In the last years the knowledge of marine biotas of the Jurassic-Cretaceous transition has improved, triggered mainly by new paleontological surveys on the Arctic territories (Kear *et al.*, 2016). In the case of marine tetrapods, the most significant findings correspond to those of the Agardhfjellet Formation (Svalbard archipelago, Norway) (e.g. Hurum *et al.*, 2012; Delsett *et al.*, 2016). Nevertheless, the structure of marine tetrapod assemblages from the J-K boundary of high northern latitudes differs significantly from that of middle southern latitude assemblages like the one presented herein. Norway assemblages are characterized by abundant ichthyosaurs and plesiosaurus and, as far as we know, no metriorhynchids or turtles have been recorded. On the contrary, Mendoza sections are characterized by abundant ophthalmosaurid ichthyosaurs and metriorhynchinae and geosaurinae metriorhynchids. The interpretation of these differences requires further scrutiny. New findings and comparisons with other localities from different paleolatitudes will undoubtedly help to understand the dynamic of marine tetrapods communities during the Jurassic-Cretaceous boundary interval.

Key words: Vaca Muerta Formation, Neuquén Basin, ichthyosaurs, metriorhynchids, ammonoid biostratigraphy.

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Figure caption:

1. Arroyo Durazno and Arroyo Paulino sections. Bz, Andean ammonoid Assemblages Zones, V.a., *Virgatosphinctes andesensis*, P.z, *Pseudolissoceras zitteli*, W.i., *Windhausenicerias internispinosum*, C.a., *Corongoceras alternans*, S.k., *Substeueroceras koeneni*, A.n., *Argentinicerias noduliferum*; 2. Study area in the southern Mendoza sector of the Neuquén Basin. Stars show studied localities; 3. Selected outcrop pictures of marine reptiles: A, Ophthalmosauridae (Py 1), partial articulated vertebral column and hindfin; B, Metriorhynchidae (DU 16-10), partially preserved skull in ventral view; C, Metriorhynchidae (DU 16-10), partially preserved skull in left lateral view; D, Geosaurinae (Py 3), skull in dorsal view; E, Geosaurinae (Py 5), dorsal and sacral vertebrae; A, C and E at Arroyo Paulino, B at Arroyo Durazno.

