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SHORT COMMUNICATION

AN AVIAN TARSOMETATARSUS FROM NEAR THE K-T BOUNDARY OF NEW ZEALAND

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Early stages of avian evolution in the Southern Hemisphere remain largely unsampled. Here, we describe an avian fossil from near the Cretaceous-Tertiary (K-T) boundary representing one of the oldest records of birds on New Zealand. The specimen comprises a tarsometatarsus diagnosable to the level of Ornithurae by two derived features: presence of a globose intercotylar eminence and presence of two proximal vascular foramina. The fossil was collected from a section cut by the Waimakariri River near Otarama Railway Station on the South Island of New Zealand (Figure 1). Morphological similarities shared with waterbirds such as Procellariiformes, Gaviiformes, and Rallidae suggest an aquatic ecology for the Waimakariri bird, but do not provide evidence for placement in any extant clade. Although fragmentary, this fossil demonstrates that birds other than penguins reached New Zealand by at latest the earliest Paleocene.

New Zealand is well known for a rich subfossil avifauna including the recently extinct moa (Dinornithiformes), flightless songbirds (acanthisittid wrens: e.g., *Pachyplichas yaldwyni*, *Dendroscansor decurvirostris*), and the giant raptor *Harpagornis moorei* (Worthy and Holdaway, 2002). In contrast, pre-Pleistocene bird fossils have long been extremely rare with the notable exception of penguins (Marples, 1952; Fordyce, 1991; Slack et al., 2006). Penguins have an extensive record in New Zealand and first appear in the late early Paleocene (Slack et al., 2006). Recently, discovery of a rich assemblage of bird bones including at least 23 species representing ducks, parrots, rails and other groups from the Miocene lacustrine deposits of the Bannockburn Formation greatly expanded the pre-Pleistocene New Zealand fossil record (Worthy et al., 2007). Nonetheless, only one non-penguin fossil has previously been described from pre-Neogene strata. This element is an incomplete furcula collected from the late Oligocene Kokoamu Greensand. Marples (1946) made this specimen the holotype of *Manu antiquus* and considered it an early record of Diomedeidae. However, Olson (1985) noted the furcula was dissimilar to that of extant albatrosses and considered the affinities of *Manu antiquus* to be uncertain. A fragment of an avian femur from the Cretaceous has also been mentioned in the literature (Fordyce, 1991), but this specimen remains undescribed. The subject of this article is a previously mentioned (Keyes, 1981; Fordyce, 1991) but hitherto undescribed tarsometatarsus. The specimen (GS12287) is part of the collections of the New Zealand Geological Survey, Lower Hutt.

The tarsometatarsus was collected from a concretionary sandstone horizon exposed at the Waimakariri River opposite of the Otarama Railway Station, approximately 80km west of Christchurch. The brachiopod genus *Lingula* is particularly well-represented, thus the horizon is referred to as the "*Lingula* beds" in some publications (Keyes, 1981; Fordyce, 1991). The concretionary layer ranges from 0-50cm thick and is distinguishable from the underlying and overlying sandstones mainly by more heavy calcite cementing and concentration of vertebrate fossils (Keyes, 1981). These fossils include a diverse array of chondrichthyans, abundant small fish bones and labrid fish teeth (Keyes, 1981).

At the Otarama section, deposits spanning the Late Cretaceous and possibly the Early Tertiary are exposed. A description of the geology at this locality was made by Keyes (1981) and is summarized below. The lower part of the section is certainly Cretaceous in age as indicated by the belemnite *Dimitobelus hectori* and two shellbeds containing the Cretaceous gastropod *Conchothyra parasitica*. Keyes (1981) placed the Cretaceous-Tertiary boundary conformably above the highest shellbed of *Conchothyra parasitica*, based on the first occurrence of the dinoflagellate cf. *Aliocysta circumtabulata* in the section. The concretionary horizon from which the tarsometatarsus was collected occurs approximately 8.5m above the level believed by Keyes (1981) to represent the K-T boundary. Given that no stratigraphic break is recognizable between the Cretaceous shellbed and the concretionary horizon, the age of the avian fossil would be earliest Paleocene under Keyes' (1981) scheme. However, since the time of Keyes' (1981) writing, *Aliocysta circumtabulata* has been reported in deposits from New Zealand on both sides of the K-T boundary (Strong et al., 1995). In the Southern Hemisphere, *Aliocysta circumtabulata* is now recognized to first appear at 68.5 Ma and last appear at 57 Ma (Williams et al., 2004). Therefore, this microfossil does not necessarily indicate a Paleocene age and the possibility that the avian fossil is instead Maastrichtian in age cannot be refuted. Other microfossils from the concretionary horizon and adjacent beds have ranges too long to further narrow the possible age of the fossil, and no radiometric dates are available to provide an absolute age.

DESCRIPTION

Anatomical terminology follows Baumel and Witmer (1993). The fossil is a partial left tarsometatarsus missing most of the hypotarsal crests, trochlea metatarsi III and much of trochlea metatarsi IV. The preserved portion measures 62.7 mm long, though if the bone were complete this length would be extended by trochlea metatarsi III. The shaft is remarkably slender and mediolaterally compressed. Despite damage to some regions, the surface of the bone is well-preserved and many muscle and ligament scars are clearly marked.

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