AN UPPER TRIASSIC (NORIAN) ICHTHYOSAUR (REPTILIA, ICHTHYOPTERYGIA) FROM NORTHERN ALASKA AND DIETARY INSIGHT BASED ON GUT CONTENTS

PATRICK S. DRUCKENMILLER, *1, 2 NEIL KELLEY, 3, 1 MICHAEL T. WHALEN, 2 CHRISTOPHER MCROBERTS, 4 and JOSEPH G. CARTER2; 1University of Alaska Museum, 907 Yukon Drive, Fairbanks, Alaska 99775, U.S.A., psdruckenmiller@alaska.edu; 2Department of Geosciences, University of Alaska Fairbanks, 900 Yukon Drive, Fairbanks, Alaska 99775, U.S.A., mtwhalen@gi.alaska.edu; 3Department of Geology, University of California, Davis, 1 Shields Avenue, Davis, California 95616, U.S.A., npkelley@ucdavis.edu; 4Geology Department, State University of New York at Cortland, P.O. Box 2000, Cortland, New York 13045, U.S.A., christopher.mcroberts@cortland.edu; 5Department of Geological Sciences, University of North Carolina at Chapel Hill, CB 3315, Chapel Hill, North Carolina 27599, U.S.A., clams@email.unc.edu

In 1950, the partial skeleton of a large vertebrate was discovered in the western Brooks Range of Alaska by a team of geologists mapping the U.S. Naval Petroleum Reserve No. 4 (now National Petroleum Reserve—Alaska). Because the preserved portion of the specimen was large (approximately 4 m in length) and found in an extremely remote location (Fig. 1), it was not collected at the time of discovery, although the site was subsequently revisited at later dates by geologists familiar with the find. A brief note mentioning the skeleton and its probable age was published 23 years later (Tailleur et al., 1973); however, the identity of the skeleton as an ichthyosaur, though suspected, was equivocal. In 2002, the specimen was relocated and collected by a team from the University of Alaska Museum, where it is now housed.

The skeleton, UAMES 2437, is significant in several regards. First, its identity as an ichthysosaur is confirmed, making it the first ichthyosaur ever found in Alaska and also the largest and most complete specimen of this clade known from the state. The skeleton is one of only a handful of other identifiable ichthyosaurs known from Alaska (Druckenmiller and Maxwell, 2013) and represents the northernmost occurrence of any well-preserved Triassic ichthyosaur in North America. Given that the global record of ichthyosaur diversity from the Late Triassic—and particularly the Norian—is poor, the specimen helps to bridge the evolutionary gap between the much better known faunas from the Middle Triassic and Early Jurassic. The specimen is particularly remarkable in preserving a discrete mass of comminuted remains of vertebrates and invertebrates within the body cavity that are most easily interpreted as gut contents, thereby providing valuable insight into the diet and ecology of Late Triassic ichthyosaurs.

**Institutional Abbreviations**—Gmr, Geological Survey of Guizhou Province, Guiyang, People’s Republic of China; IVPP, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, People’s Republic of China; UAMES, University of Alaska Museum, Fairbanks, U.S.A.

**GEOLOGIC SETTING**

In northern Alaska, Triassic marine rocks crop out across most of the northern front of the Brooks Range and extend into the North Slope subsurface. In the north-central and western Brooks Range, Lower Triassic–Lower Jurassic rocks make up the Otuk Formation (Mull et al., 1982) characterized by condensed, deeper-water facies of organic-rich mudrocks, bedded chert and limestone, all rich in bivalves and radiolaria (Bodnar, 1984; Blome et al., 1988; Kelly et al., 2007). The Otuk Formation (Fig. 2) contains the informally designated shale, chert, and limestone members (Patton and Tailleur, 1964) and the formally designated Blankenship Member (Mull et al., 1982; Bodnar, 1984; Blome et al., 1988). Biostratigraphically significant bivalves are rare in the Otuk shale member but become increasingly common in the middle to upper chert member and limestone member (Kelly et al., 2007). The Carnian–Norian boundary in the lower chert member is constrained by the stratigraphic position of Halobia ornatisima, H. beyrichi, and H. cordillerana (Fig. 2). The Triassic–Jurassic boundary is located at the top of the limestone member and is constrained by the stratigraphic position of Monotis subcircularis in the lower limestone member and Otapia taitleri in the overlying Blankenship Member (Kelly et al., 2007).

The ichthyosaur was collected at Cutaway Creek (Fig. 1) from the Otuk limestone member, which contains thin chert interbeds (Tailleur et al., 1973). Bivalve biostratigraphy indicates that the limestone member is late Norian in age (Kelly et al., 2007), and this is corroborated by recent work on a subsurface drill core that penetrated the Otuk Formation near the Red Dog massive sulfide deposit that documented late Norian radiolaria in the limestone member (Dumoulin et al., 2011). Kelly et al. (2007) interpreted the limestone member as the final portion of a late Norian progradational event. The lack of wave- or current-derived sedimentary structures and the trace and body fossils observed suggest deposition below storm wave base in an outer neritic to inner bathyal setting.

**MATERIALS AND METHODS**

The specimen was mechanically prepared using an air abrasive and sodium bicarbonate powder in order to remove an encrusting layer of lichen. Due to the extreme hardness of the matrix, a hammer and chisel were selectively used to remove pieces of matrix, particularly in the forefin area. Measurements less than 10 cm were made with dial calipers. A skeletal map (Supplementary Data, Fig. S1) was derived from a digital photomontage made in Adobe Photoshop CS3 and verified through examination of the actual specimen. Petrographic thin sections were prepared from the rock surrounding the skeleton. Small pieces (<2.0 cm long) of matrix and macerated organic material from the probable gut contents were also removed from the block in