FOSSIL CROCODILIAN DISTRIBUTIONS, UPPER CRETACEOUS TO PRESENT: IMPLICATIONS FOR PALEOCLIMATE.

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The present day distribution of crocodilians appears to be climatically controlled, at least in part, with the group restricted to tropical through sub-tropical regions. Studies have shown that although crocodiles may be able to withstand sub-zero temperatures they can do so for only limited periods. By analogy the presence of fossil crocodilians in the geologic record has been interpretated as indicating warmth. However previous studies have generally been of limited scope. This study uses global paleodistributions of the crocodilians to map gross global climate for the last 100 million years.

A comprehensive database of published occurrences of fossil crocodilians from the late Cretaceous to the Present has been constructed. Taphonomic and collection biases have been addressed using 'control groups', these are respectively the Testudines and the vertebrates in general. Problems of taxonomic inconsistency have been dealt with by 'accepting' a standard published taxonomic scheme (Carroll, 1988). Geographic and temporal uncertainties and imprecisions are coded on the database to facilitate sorting; this allows the analyses to be run at different levels of precision and provides an opportunity to understand the way biogeographic and hence paleoclimatic interpretations may be influenced by both the nature of the geologic record itself and by a priori decisions made by the worker. The database also includes lithologic, stratigraphic and environmental information on some 3300 localities and includes specimen information for the taxa entered (>14000 separate entries assembled from 1000 references).

Preliminary analyses of paleolatitudinally reconstructed localities reveals the following trends: an overall equatorward movement of the poleward limit of the crocodiles from the late Cretaceous to the present; this is punctuated by an abrupt equatorward excursion of almost 10° during the Oligocene and another of similar magnitude at the end of the Miocene, with an apparent Miocene 'recovery' in between (this trend is shown most clearly by the families Alligatoridae and Crocodylidae). At the suborder level the Mesosuchians (excluding the Sebecidae) show a distinct equatorial shift from the Campanian through to the middle Eocene when they disappear; inclusion of the Sebecidae in the Mesosuchia gives rise to a sudden poleward expansion in the middle Eocene of some 20° paleolatitude. Map reconstructions, especially for North America, reveal an eastward shift of crocodilian localities as the Tertiary progresses, perhaps due in part to a taphonomic artifact, viz., the migration of the locus of sedimentation. With the late Miocene the crocodilians disappeared completely from the continental interior record, a transition which seems tied to increased aridity (as indicated by the development of caliches in many areas) and increased seasonality of temperature. This pattern is also seen in the southern 'U.S.S.R'.

The distributions of the Crocodylia through time therefore reflect and support established views concerning late Cretaceous through Tertiary climate with a general cooling trend from the late Cretaceous to the present punctuated by abrupt coolings in the Oligocene and around the Miocene-Pliocene boundary.