PALEOENVIRONMENTS OF ROOT CASTS FROM THE KOOBI FORA FORMATION, KENYA

ANDREW S. COHEN
Department of Geology
University of California
Davis, California 95616

ABSTRACT: A study of fossil roots and root casts from East Turkana, Kenya, has shown them to be useful paleoenvironmental indicators. Fossil root casts were obtained from the Pleistocene, Upper Member of the Koobi Fora Formation, deposited within the East Turkana Embayment of the Lake Turkana Basin. Lithofacies and biofacies analysis of the study locality allows the discrimination of several important environments which contain root casts, notably fluvial channels and shallow lacustrine conditions.

Five common root cast morphologies have been observed: 1) horizontal, planar root mats; 2) vertical or vertically branching structures; 3) horizontal or horizontally branching structures; 4) diagonal branching structures; and 5) root "balls" (concretionary structures). Root cast morphology is shaped both by the original root morphology and post-mortem, diagenetic development. Line transect surveys of fossil root casts reveal two striking lithofacies-root cast associations. Laminated silstones of the shallow lacustrine environment primarily contain root mats and horizontal roots, whereas sandstone-conglomerates of the fluvial paleochannels contain predominantly vertical and diagonal root casts, with no root mats.

Studies of plant associations in the Lake Turkana area, and work on modern root morphologies suggest a probable explanation for these associations. In arid environments, water availability is a dominant factor in root morphology. Plants growing along intermittent streams or floodplains must frequently rely on perched water bodies or deeper phreatic water, therefore sending out long, vertical tap roots to take advantage of this resource. Plants living in permanent, shallow lacustrine environments or other areas where phreatic water is quite shallow have no such requirement, since their roots are nearly continuously immersed in ground water; during floods the plant stalk itself is subaqueous. The roots of these plants tend to extend laterally in thin mats over large areas. Thus, a study of root cast morphologies may allow for an assessment of paleogroundwater conditions in nonmarine sediments.

INTRODUCTION

The study of trace fossils as paleoenvironmental indicators has received considerable attention during the past twenty years. Most of this effort has been directed towards an understanding of marine invertebrate traces; this is logical enough considering their overwhelming importance in the fossil record. The probability that nonmarine lebensspuren, in particular those of plants, might be used for similar ends did not escape the attention of Glennie and Evamy (1968) and Sarjeant (1975) in their discussions of the subject. In this paper I present results of a study of fossil root casts from East Africa. I will attempt to show how root cast morphology can be used to deduce variations in nonmarine paleoenvironments which might otherwise go unrecognized using more traditional sedimentological methods. The model which I present appears to have considerable explanatory power in the interpretation of facies deposited under arid conditions, but I would caution against its more general application to all subaerial deposits in the absence of new comparative studies from a variety of humid environments.

The root casts discussed in this paper were obtained in 1978 from the Upper Member of the Pliocene-Pleistocene Koobi Fora Formation, which crops out discontinuously along the northeast margin of Lake Turkana (formerly Lake Rudolf, see Fig. 1) in the vicinity of the Koobi Fora Ridge. The regional geology has been discussed by Vondra and Bowen (1978) and Findlater (1976) (Fig. 2), and their studies of the environments of deposition of these sediments have been of wide interest because of a relatively abundant hominid fauna (Leakey and Leakey, 1978).

The Koobi Fora Formation was deposited in

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2Present address: Department of Geology, Colorado College, Colorado Springs, Colorado 80901.
a northeastern extension of the Lake Turkana Basin. In most areas fluvial and fluviodeltaic sediments to the east grade laterally westward into coastal plain-deltaic and lacustrine deposits (Vondra and Bowen, 1978). Intercalated with these sediments is a series of laterally extensive, reworked ash tuffs, which have provided one of the principal tools of correlation within the basin (Findlater, 1978). One of these tuffs, the 15-meter-thick Koobi Fora Tuff Complex (Figs. 3 and 5) which was assigned an Ar/Ar age of 1.57 ± 0.00 m.y. by Fitch and Miller (1976), has been mapped at 1:3600 scale by the author in a small area south of the Koobi Fora Ridge (Fig. 4). Most of my observations are based upon detailed studies of fossil root casts from within and immediately above the Koobi Fora Tuff Complex within the mapped area, and from exposures of the presumably isochronous Okote Tuff (Behrensmeyer and Laporte, 1981), which is exposed to the northeast of the primary study area. Observations from other stratigraphic horizons in the Koobi Fora Formation and from late Pleistocene lacustrine deposits with root casts from the Northern Sierra Nevada of California appear to corroborate the results obtained from the Koobi Fora Tuff Complex roots.

**STRUCTURE, STRATIGRAPHY, AND PALEONVIRONMENTS OF THE KOOBI FORA TUFF COMPLEX (FIG. 3)**

Broad features of the fluvo-lacustrine paleoenvironments for the Koobi Fora Formation were discussed by Findlater (1976). He suggested that the Koobi Fora Formation in the

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**Fig. 1.** Location map of East Turkana and root cast study area. Outcrop area of the Upper Member of the Koobi Fora Formation is shaded. The region lies somewhat east of the Gregory Rift Valley in a region of more complex faulting known as the Turkana Depression. Adapted from Vondra and Bowen (1976).

**Fig. 2.** Stratigraphy of the East Turkana Embayment. Radiometric ages are in millions of years except for the Holocene Galana Boi Beds as noted. Thicknesses are approximately to scale. The Koobi Fora Tuff Complex, discussed in this paper, lies within the Upper Member of the Koobi Fora Formation and is indicated by the dated horizon 1.57 m.y. Data from Vondra and Bowen (1976), Findlater (1976), Fitch and Miller (1976), and Drake et al. (1980).
Fig. 3.—Representative stratigraphic section of the Koobi Fora Tuff Complex at the study area. Environmental interpretation for each facies are given on the right, as well as the corresponding map units for Figure 4. Stratigraphic horizons at which root transect surveys were made are shown on the left. Extremely rapid facies transitions both vertically and laterally are the rule in this region, which during the period of deposition of the Koobi Fora Tuff Complex lay in an area of intersection for several depositional environments. See text for a more detailed discussion of lithologies.

vicinity of the study area represents a large deltaic complex emptying into Paleolake Turkana, the depocenter of which migrated north and south through time. This migration, coupled with climatically and tectonically induced lake level fluctuations, has yielded a highly complex lithologic sequence through the Upper Member of the Koobi Fora Formation, in which vertical facies variations often occur over a scale of less than one meter.

The study area for this paper (Area #103 of the Koobi Fora Research Project) is situated on two north-northeast trending fault blocks; these closely reflect the regional structure, in which high angle, normal faults are associated

Fig. 4.—Geologic map of study locality. Areas where root transects were made are indicated. Several transects were made in the vicinity of each marked site.

Fig. 5.—The Koobi Fora Tuff Complex, northeast of the study site.
with gently, westward dipping beds. Fault throws are typically on the order of less than 20 meters in the 103 area, although they are frequently stepped en echelon to yield greater cumulative displacements. Folding of the Koobi Fora Formation appears to be of minor importance in the immediate study area, although broad anticlinal warping does occur nearby. Most variations in local dip reflect irregularities on the depositional surfaces (which are always gently dipping towards the lake) or, less commonly, penecontemporaneous slumping.

Four lithofacies can be observed within the study area. They are briefly discussed here in the order in which they appear stratigraphically within the study area.

**Brown Silty Sands and Sandy Silts**

The sands and silts are moderately sorted, with poorly developed soil horizons in some places. Abundant mammalian footprints and unidirectional (east-west) current indicators (in particular, oriented long bones) occur in this facies within the study area. Penecontemporaneous cracking, possibly due to subaerial exposure, as well as mud clasts have been observed. This facies coincides with map unit 1 in the study area, the upper contact being recognized by the lowest occurrence of tuffaceous sediments, and a typically coincident, buff soil horizon.

This facies is interpreted as having been deposited on a delta plain, principally, though not exclusively, under subaerial conditions.

**Impure, Tuffaceous Sandy Silts and Laminar to Planar Cross-bedded Sands**

This facies contains abundant reworked molluscan shell lags, burrow structures, and occasional root casts. Sands and sandy silts are often interdigitated on an extremely local scale. Climbing ripple marks and channels are occasionally found associated with the cross-bedded sands. Fine silt lenses, often secondarily calcrited, occur sporadically, as do small lenses of pumiceous gravels. In some places there is evidence of soft-sediment deformation.

This facies appears to have been deposited on the constantly shifting margin between delta and coastal plain environments, at or near the upper edge of the littoral zone. The first and all subsequent appearances of tuffaceous material within the study area suggest water-lain rather than airfall conditions. This conclusion is more broadly supported by studies by Cerling (1977) and Findlater (1976).

**Gray and Brown, Laminated and Ripple-laminated, Siltys and Sandy Siltstones**

The so-called laminated siltstones (discussed more fully by Vondra and Bowen, 1976) contain abundant calcareous concretions, fish and mammal fossils, burrows, and root casts. Both fining- and coarsening-upwards sequences of pumiceous gravels and sands occur locally. A prominent and widespread oolitic-pisolitic bed with associated biscuit stromatolites occurs with the laminated siltstone facies in the study area, where it marks the contact between map units 2 and 3. These features have been more fully described by Schwartz (1981).

**Nontuffaceous (Within the Study Area), Poorly Sorted, Reddish-brown Sandstone-Conglomerate Facies**

Abundant channel scours within this facies contain fining-upwards, muddy gravels and sands. These are interbedded with moderately sorted silt and sand lenses. Bedding is massive and discontinuous laterally. Large root casts are very common, but otherwise fossils are rare. Tabular, calcareous concentrations are also abundant. In the study area, the contact between map units 3 and 4 coincides with the facies transition between underlying tuffaceous silts and sands and the overlying, nontuffaceous, sandstone-conglomerate facies. This contact also marks the upper boundary of the Koobi Fora Tuff Complex. In other areas at East Turkana, however, the sandstone-conglomerate facies described here can be highly tuffaceous, the distinction (tuffaceous versus nontuffaceous) being only of value locally.

The sandstone-conglomerate facies corresponds with a multistoried fluvial deposit, with distributary-channel bar, and interdistributary crevasse splay and overbank deposits being represented.

**ROOT CAST MORPHOLOGY**

Since root casts are not directly analogous to living root structures, it is not always possible or even desirable to apply the terminology commonly used by botanists for root structures to them. I therefore designed a sim-
ple system of classification which could be used in the field and is nongenetic. Root casts at East Turkana can usually be easily placed in one of the five following categories:

1) **Horizontal, planar root mats.** These root mats are composed of interwoven, thin (less than 5 mm) root casts, typically with individual roots lying in the same plane as the mats. The mat itself may be up to 5 cm thick and may extend laterally to cover hundreds of square meters (Fig. 6A).

2) **Vertical root casts.** This includes all individual roots in a predominantly vertical position. Sometimes they reach thicknesses of 10 cm in the case of probable tap root casts from trees. Most are relatively straight with changes in orientation occurring at points of bifurcation.

Fig. 6.—Root cast morphologies. A) Root mats interbedded with laminated silts. Arrows indicate the irregularly textured mat horizons, each of which is approximately 5 cm thick. B) Vertical root casts (indicated by arrows) in trough cross-stratified pebbly sandstone. C) Horizontal root casts (1) with attached root balls (2). The unattached, globular structures (3) to the left and in front of the root casts are believed to be fossil termite chambers (Behrensmeier, pers. comm.). String running lengthwise across the photograph is 1.5 m long. D) Diagonal and vertical roots weathering out of planar cross-stratified channel fill.
along the root (Fig. 6B).

3) Horizontal root casts. These include all horizontal and subhorizontal (plunge less than 15 degrees), discrete root casts. Unlike a vertical root, they are rarely straight for more than a few tens of centimeters. Usually their diameter is less than 2 cm (Fig. 6C).

4) Diagonal root casts. These are casts with attitudes between 15 degrees from the horizontal and 15 degrees from the vertical. They usually form at points of bifurcation along tap root casts or around obstacles in the sediment (Fig. 6D).

5) Root balls. These are relatively uncommon globular structures that may form around any of the previously mentioned root cast types. They are, however, more abundant on vertical and horizontal root casts, for reasons which will become evident later in this discussion (Fig. 6C).

In addition to these five common root cast structures, I have observed a sixth variety, root nodules, in the Ileret region (Fig. 1). Root nodules are small, ball-shaped structures interconnected by numerous horizontal root casts. They are superficially similar to root balls but have a much more regular morphology, and their relationship with discrete horizontal root casts seems to be unvarying.

FORMATION AND DIAGENESIS OF ROOT CASTS

The term root cast is perhaps an unfortunate choice of words to describe this type of root trace fossil, because its mode of formation is not truly analogous to a typical fossil cast. Root casts are not simply the sand and cement infilling of hollow spaces left behind by decaying roots. In fact, the original root space probably accounts for only a small part of the root cast volume. Observation of recent incipient root casts at all stages of development throughout the East Turkana area suggests the following scenario for root cast formation.

Apparently when the root decays a small cavity may develop. These are occasionally observed in the field, unfilled for some reason. First, the cavity itself serves as a groundwater conduit, transporting calcareous caliche or gypsum surfacemwards (Hardie et al., 1978; Hunt, 1966). Second, the root decay may mobilize pedogenic calcite, which is continually percolating upwards in the desert soil profile, by introducing temporarily acidic conditions in the zone immediately around the root. Calcification will set in quickly, however, once the normally high pH conditions of the soil are reestablished. The presence of garbage, possessing calcite rinds, left behind by excavation crews during the past 12 years suggests that this process occurs quite rapidly in this area.

A detailed account of the diagenesis of root casts and other calcareous cementations found in the East Turkana area is currently in preparation (Mount and Cohen, in prep.). Preliminary petrographic examinations of root casts suggests that depending on the location of the root, the cavity will be infilled by a combination of clay or sand and silt, coming from either the collapse of the root cavity walls or washed in from outside the root cavity. Sparry and drusy calcite (Fig. 7A) will begin to replace feldspar and lithic grains almost immediately when the pH becomes high enough (this can be seen in subrecent root cavities). Clays, where present, usually become strongly indurated during cementation. Most spars appear to have been secondarily micritized. Later many of these micritized spars are recrystalized into optically continuous crystals. In other words, several generations of cementation appear to have occurred. Fabrics which are suggestive of both vadose and phreatic cementation have been observed (Fig. 7B). Their relationship to specific root casts morphologies will be discussed in a future contribution (Mount and Cohen, in prep.).

To this point, the process of root cast formation essentially parallels that of other fossil casting processes. However, the cementation of root casts will frequently continue concentrically outwards from the original root cavity, invading the host rock. The zone of cementation may greatly exceed the original root diameter. It appears that root balls are formed locally in this fashion, which would explain their absence in modern plants. The cementation may continue indefinitely outward from the root. In sand-silt interbeds, where the migration of pore fluids is most easily facilitated along bedding planes, the "root casts" may develop into larger, tabular, calcareous concretions, parallel to bedding, as opposed to the globular root balls typical of roots crossing bedding planes. The evidence for these developments lies in the frequent discovery of incipient concretions and root balls around root
casts at all intermediate stages of development.

METHODS

Due to the absence of a uniform terminology for the description of root casts, let alone an accepted methodology for their study, it was necessary for the purposes of this study to design such a technique. Ideally any experimental method for dealing with these structures should also be capable of direct application with living roots. This is imperative if ecological and physiological comparisons are going to be made between the fossil and living populations.

The method which I used employed 10-meter transects along which a string was placed. The starting point was chosen randomly, and the string was stretched along the direction of strike, such that the string was both horizontal and approximately on a bedding plane.

Each new transect would be placed a predetermined horizontal distance from its neighbor (usually 10 m) in order to avoid the sampling bias of placing transects over larger, more obvious roots. Every root which the transect crossed was noted and tabulated according to one of the five common morphologies previously discussed. Only the morphology at the actual intersection of the root cast and string was noted, thus a horizontal root with a root ball on it at the point of intersection would be noted as a root ball, regardless of the length or size of the horizontal root (Fig. 8). Roots which had multiple crossings of the same string were counted each time they crossed. Superficially it might seem that this would introduce error, in that a subhorizontal root cast is likely to make many passes across the string, but in fact it must be remembered that the likelihood of a given horizontal root occurring at just the right elevation to cross the string at all is proportionately smaller. It can be shown mathematically that such a sampling method provides in one dimension (along the transect) ratios of root cast types which are equivalent to their true numerical ratios (Chayes, 1956).
Fig. 8.—Root cast transect survey. A) Transect line (10 m long) is run across the outcrop surface parallel to strike, and each root crossing is noted. B) A large diagonal root cast (indicated by the arrow) is adjacent to, but not crossing, the transect line and therefore is not counted.

Root cast transects were taken in two distinct lithofacies groups (discussed earlier), which may be considered as endpoints in future discussion along an environmental gradient: 1) Fine-grained laminated or blocky tuffaceous silts [as previously stated, these have been recognized as having been deposited in a variety of shallow lacustrine environments (Fig. 9A)]; 2) Cross-bedded, channeled coarse sands and conglomerates, with associated planar-bedded silts and sands [again these are recognized as fluvial, interdistributary and overbank deposits, and lie stratigraphically 5 to 10 meters above the lake beds (Fig. 9B)].

Twenty 10-meter transects were taken in each lithofacies group.

RESULTS

The results of the two transect surveys are shown in Figure 10. In most respects the totals

Fig. 9.—Representative lithologies from which root transect surveys were taken. A) Laminated siltstone facies, interpreted as having been deposited under shallow lacustrine conditions. B) Trough cross-bedded channel sands, deposited by ephemeral streams.
are radically different. Particularly significant are the different vertical root and root mat frequencies between the two lithologies. Root mats are an exclusive feature of the lagoonal deposits, whereas vertical root casts occur primarily in the channel and floodplain deposits. Only the root balls show a similar frequency between the two sets of environments. This is hardly surprising considering their diagenetic origin.

**COMPARISON WITH LIVING PLANTS AT EAST TURKANA**

Studies of the ecophysiological constraints on root growth and morphology by Cannon (1911), Weaver (1958b), Coupland and Johnson (1956), and Jenik and Harris (1969) have elucidated many of the basic relationships between root structure and water availability. Weaver (1958b) has stated that although other environmental factors may have limited effects on root growth, in dry climates the soil and upper bedrock water saturation, and in particular its seasonality, are the key responsible factors for most primary tap and lateral root structure development.

At East Turkana the arid climate has resulted in a semidesert flora. Vegetation is sparse except in areas of abundant surficial or subsurficial water. These more heavily vegetated environments include the following: 1) gallery forest along occasional water courses (Fig. 11A); 2) floodplains of occasional watercourses (Fig. 11B); 3) Coastal plain grasslands around Lake Turkana (Fig. 11C); and 4) reed swamps around Lake Turkana (Fig. 11D).

Notice that in the first two environments the surface water supply is intermittent, coming mostly during the short rainy seasons. During the remainder of the year, plants in these environments must either rely on storage organs (actually a feature of even more xeric environments such as rocky deserts) or else take advantage of perched water bodies in the subsurface. Within the watercourse itself these may be quite common. In the flood plain, a
more typical situation would be for the plant roots to extend down to the phreatic zone itself, which in the immediate vicinity of the stream bed may not be very deep. In either case, it is clearly an advantageous strategy for plants in these environments to develop long vertical tap roots, passing through the vadose zone, in order to exploit this resource (Weaver, 1958b).

In contrast to these conditions, plants growing under the second two categories face a different environmental challenge. In the areas immediately adjacent to Lake Turkana, water-saturated soils are a permanent condition, and in the case of the reed swamps, the plants are inundated subaerially most of the time, at least at their bases. Water availability is no longer a limiting factor for plant growth, and the elaborate taproot networks of drier-area plants are not longer necessary. Under such circumstances the roots of local plants may be expected to grow laterally in thin horizontal sheets with little or no deep penetration of the soil profile. As an example of this phenomenon, we may consider the grass *Sporobolus spicatus* (Fig. 11C), a common species of Northern Kenya. *S. spicatus* is most frequently found in coastal plain environments and around marshes near the water's edge. Less frequently, however, it may also occur on drier ground, especially in dry stream beds. Its root structure is highly variable between these two environments, with a considerable increase in vertical roots being observed as one moves from the former environment to the latter. A similar phenomenon was observed by Coupland and Johnson (1956) in their study of native grassland species rooting characteristics in
the Canadian Great Plains. The important forb *Artemisia frigida* (Fig. 12) has a root system whose morphology is highly dependent on moisture availability in the upper soil horizons. Thus, root morphology may be a direct indicator of the local water source condition at the time of root growth. For instance, permanently flowing streams should encourage the growth of a flora which has continual access to surface waters, and under such conditions in East Africa today, vegetative swamps, with shallow root masses, peripheral to the main water course frequently develop (Beadle, 1974).

In an area adjacent to the fossil root cast study site, where modern streams have cut channels into an older floodplain around Lake Turkana (Fig. 13), it is possible to compare modern root assemblages with their fossil counterparts. A technique identical with that already described was used for modern roots, with the exception that roots and root hairs under 1 mm in diameter were not counted, since they are unlikely to be fossilized. Twenty 10-meter transects were made; the results are illustrated in Figure 14. Notice, first, the absence of root mats. It is this absence and the overwhelming abundance of vertical roots which is significant when compared with the fossil root casts. These results are qualitatively identical with those from the Pleistocene depositional environments; and the results from the Pliocene depositional environments were based entirely on lithological criteria to avoid any possibility of circularity in this reasoning.

Ideally, transects in modern lagoons or reed swamps should have been made for comparison with the fossil root data. Unfortunately, this was logistically impossible, given the impracticality of making extensive trenches at and below the modern water table (not to mention the fact that these swamps are a favored habitat for the Nile crocodile!). It was possible, however, to make small trenches in which the swamp roots could be observed, if not actually counted (Fig. 15). In all circumstances where this was done along the lakeshore the results were identical. Reeds such as *Typha* sp. and *Paspalidium* sp. have uniformly, shallow roots which are tightly interwoven (and very difficult to dig into) and are laterally quite extensive.

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**Fig. 12.** —*Artemisia frigida*, a grassland forb from Saskatchewan and its rooting characteristics. The plant’s root system morphology is highly dependent on local environment conditions, primarily with respect to soil texture and groundwater availability. A) *A. frigida* from stabilized sand with adequate surficial moisture. B) *A. frigida* from a lower, loamy slope with little surficial moisture. Adapted from Coupland and Johnson (1965).

**Fig. 13.** —Exposed root systems of several semidesert shrubs along an incised channel wall near the study area. Notice the preponderance of vertical and diagonal roots.
Fig. 14.—Living root transect survey data. Abbreviations and data manipulations are explained in Figure 10. As with the fossil root casts, living plants along the banks of ephemeral streams develop numerous, deeply penetrating roots, relatively few horizontal roots, and no root mats. Root balls, a diagenetic by-product of fossil root cast formation, are absent from the roots of living plants.

DISCUSSION

This study of fossil root casts and their modern analogues must be considered preliminary, in the sense that data were gathered in a geographically and temporally restricted setting. Nevertheless, the results are important because they suggest avenues of research where these ideas can be more fully tested. More general models, incorporating root development in a variety of humid and temperate environments, are clearly desirable and must be developed before root casts can be used as effectively in subaerial deposits, as paleoenvironmental indicators, as marine invertebrate trace fossils are in marine deposits.

Notwithstanding these difficulties, root casts have been shown to be useful in distinguishing several important nonmarine environments (Fig. 16).

Areas of deposition in which water is only sporadically available at the surface but usually available in the subsurface will have a root flora dominated by long vertical tap roots. Occasionally these roots at their base will spread laterally when water or an impermeable layer is reached, but the horizontal root network will be relatively loose.

Areas which are at or below water table for much of the year will encourage the development of thin root mat horizons in which the

Fig. 15.—Excavated *Parapalidium* sp. The root system of this aquatic macrophyte is quite shallow, consisting of laterally extensive, horizontal roots (arrow).
root network is intricately interwoven and below which few vertical roots descend.

In ancient fluvial environments, the above observations may allow distinction to be made between those streams which are permanently flowing (and hence would have abundant areas of perennially swampy, root-matted vegetation along their banks) and those, like the modern streams of East Turkana, which flow only during brief parts of the year and which have deeply rooted vegetation around them. This distinction takes on special significance in the Koobi Fora region where much debate has centered around whether major Pliocene-Pleistocene streams ran throughout the year (Vondra and Bowen, 1976). The evidence discussed here would suggest that they did not.

Of more general interest within this same theme are the implications root cast studies might have for paleoclimatic information. Within a single geographic locale, a distinct variation in the proportion of root cast types within fluvial and overbank deposits could conceivably be used in the interpretation of changing precipitation patterns.

In poorly exposed mudstones, where the geometry of the deposit is not well understood, root casts might be used to distinguish the various types of fine-grained nonmarine facies and their concomitant environments (for instance to distinguish overbank muds from those deposited in wave-baffled swamps). These are merely a few of the potential uses towards which a root cast study might fruitfully be applied.

SUMMARY

In this paper I have tried to show how fossil root casts can be used in paleoenvironmental reconstruction of certain nonmarine environments, where they are abundant and can be individually associated with a particular stratigraphic intervals and lithofacies. At Koobi Fora, Northern Kenya, Pliocene-Pleistocene sediments of the East Lake Turkana Embayment contain abundant fossil root casts. Comparative data from fossil and modern root studies suggest that in arid climates, gross root morphology has a strong correlation with water availability. Plants growing in depositional environments which have continual access to surface water will develop shallow and often matted root systems. In contrast to this, plants growing over subsurface water sources develop substantial vertical root systems to tap the ground water. Fossil root cast morphologies accurately reflect these tendencies; in doing so they may provide the geologist with paleoenvironmental and paleoclimatic data which would otherwise be unobtainable.
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