Joannea Geol. Paläont. 6: 29–43 (2005)

Geology, Paleontology and Paleoanthropology of the Mount Galili Formation in the southern Afar Depression, Ethiopia – Preliminary results

Geologie, Paläontologie und Paläoanthropologie der Mount Galili-Formation in der südlichen Afarsenke Äthiopiens – Erste Ergebnisse

Proceeding of PANGEO Austria 2004 in Graz

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4 Figures and 1 Table

Abstract: Research of the international PAR (PaleoAnthropological Research) team under the leadership of the Institute for Anthropology, University of Vienna, started in 2000 and will be continued over the next years in the southern Afar Depression of Ethiopia. The Pliocene sedimentary succession represents the eastern rift shoulder of the northernmost Quarternary active segment of the Main Ethiopian Rift. Lithostratigraphically, the fossiliferous lacustrine and fluvial deposits, as well as the intercalated volcanic layers of the Mount Galili Formation in the PAR excavation area, belong to the "Upper Stratoid Series" (5–1.4 Ma). Volcanic marker beds comprising basalts, ignimbrites, pumice and lapilli tuffs were used for a subdivision into lithostratigraphically defined members. Thereby, the geochemistry of the basalts indicates the magmatotectonic setting in the transitional zone between continental and oceanic rifting. Several hominid remains from Galili highlight the importance and fossil preservation potential of the southern Awash region of Ethiopia.

After MACCHIARELLI et al. (2004) results from first comparative analyses of a hominid tooth (specimen GLL33) illustrate morphological affinities to *Australopithecus afarensis* (JOHANSON, 1978) and *Australopithecus anamensis* (LEAKEY, 1995). The geological and faunal context indicate an Early to Middle Pliocene age for GLL33 representing a male individual of advanced age-at-death. The recovered faunal remains indicate a landscape of woods and grassy woodland differentiated by a river and lake system with seasonal dry periods.

Zusammenfassung: Die Forschungsarbeit des internationalen paläoanthropologischen PAR (PaleoAnthropological Research) Teams unter der Führung des Instituts für Anthropologie (Universität Wien) begann im Jahr 2000 und wird in der südlichen Afarsenke über die nächsten Jahre hinweg fortgeführt. Die pliozänen Sedimente des Untersuchungsgebietes repräsentieren die östliche Riftschulter des nördlichsten, bis ins Quartär aktiven Teils des Äthiopischen Rifts. Lithostratigrafisch werden die fossilführenden lakustrinen bis fluviatilen Ablagerungen gemeinsam mit den zwischengeschalteten Vulkaniten im Grabungsgebiet des PAR Teams als Mount Galili-Formation bezeichnet und den „Upper Stratoid Series" (5–1,4 Ma) zugeordnet. Vulkanische Leithorizonte (Basalte, Ignimbrite und Tuffe) bilden die Grundlage für die stratigrafische Untergliederung der gesamten Abfolge in einzelne Subformationen. Die Geochemie der Basalte weist auf den Übergangsbereich von kontinentalem zu ozeanischem Rift hin. Zahlreiche Hominidenfunde aus dem Arbeitsgebiet weisen auf die Wichtigkeit und das Potential für künftige Fossilfunde im südlichen Awash-Tal Äthiopiens hin. MACCHIARELLI et al. (2004) dokumentieren in einer ersten Analyse eines Hominidenzahnes (GLL33) aus dem Arbeitsgebiet morphologische Ähnlichkeiten mit *Australopithecus afarensis* (JOHANSON, 1978) und *Australopithecus anamensis* (LEAKEY, 1995). Das geologische Umfeld und die Faunenelemente deuten auf ein frühes bis mittelpliozänes Alter für diesen Zahn, der von einem männlichen Individuum in fortgeschrittenem Alter stammt. Mit der bisher gefundenen Fauna kann eine Waldlandschaft, unterbrochen von größeren Grasflächen und geprägt durch ein Fluss- und Seesystem mit saisonalen Trockenperioden, als wahrscheinliches Umfeld rekonstruiert werden.

Key Words: Ethiopian Rift; Hominid-bearing sediments; Pliocene fauna.

Schlüsselworte: Äthiopisches Rift; Hominiden-führende Sedimente; Pliozäne Fauna.

Contents

1. Introduction

Since 2000, the international PAR (PaleoAnthropological Research) Team has been investigating the Plio-/Pleistocene sediments around Mount Galili in the southern Afar Depression (Seidler et al. 2000; Weber et al. 2001). The Galili area represents a significant Ethiopian location of hominid remains east of the Awash River and about 10 km east of the village Gedamyto. Geological and paleontological study led to several paleoanthropological discoveries in this cooperative project between Austrian, Ethiopian, German, Italian and American research institutions. The geological investigations of the Department of Geological Sciences (University of Vienna) support the excavations in the Galili area under the leadership of the Institute for Anthropology (University of Vienna). The localities discovered so far are very promising for more complete hominid specimens, especially at those sites where excavations are in progress or planned.

1.1. Geological framework in the Galili area

The research area (Fig. 1) is located 100 km towards the NE of the Awash Railway Station, E of the National Road No. 8, in the district of the village Gedamyto (9°44.101'N/ 40°27.368'E). Mount Galili is the most conspicuous elevation in the center of the research area.

The deposits built up the eastern rift shoulder of the N–S striking, recently active graben structure of the Main Ethiopian Rift. The region, extensively faulted by N–S striking normal faults, exposes a sedimentary succession intercalated by volcanic marker beds used for member subdivision. The lithostratigraphically defined Mount Galili Formation (Fig. 1) has been divided into five members: Caashacado Member, Dhagax Member, Shabeley Laag Member, Godiray Member and Dhidinley Member.

They comprise volcanic layers with different lithologies such as ignimbrites, basalts and tuffs representing typical bimodal volcanism of rift zones. Stratigraphically, the fossiliferous lacustrine and fluvial deposits, as well as the intercalated volcanic horizons of the Mount Galili Fm. in the PAR excavation area, belong to the „Upper Stratoid Series" (5–1.4 Ma; Varet 1978).

1.2. Paleoanthropological Research and in situ excavations

The sites within the Galili area (Galili and Satkawhini) fill the geographical gap between fossiliferous localities of the Middle Awash Valley to the North and localities within the Shungura Formation in the southwestern Ethiopia. The primary method at the beginning of the field activities was surface survey. This was supplemented since 2003 by in situ excavations at particularly fossiliferous spots. These excavation activities produced abundant primate findings and will be further expanded into several other localities. Both surveying and the excavations yielded several hominid findings comprising four isolated teeth from different localities and tentatively one postcranial element (clavicula). The remote geographical position of other known sites, implications for an Early to Middle Pliocene age and the newly discovered localities turn Galili into one of the most interesting research areas in Ethiopia.

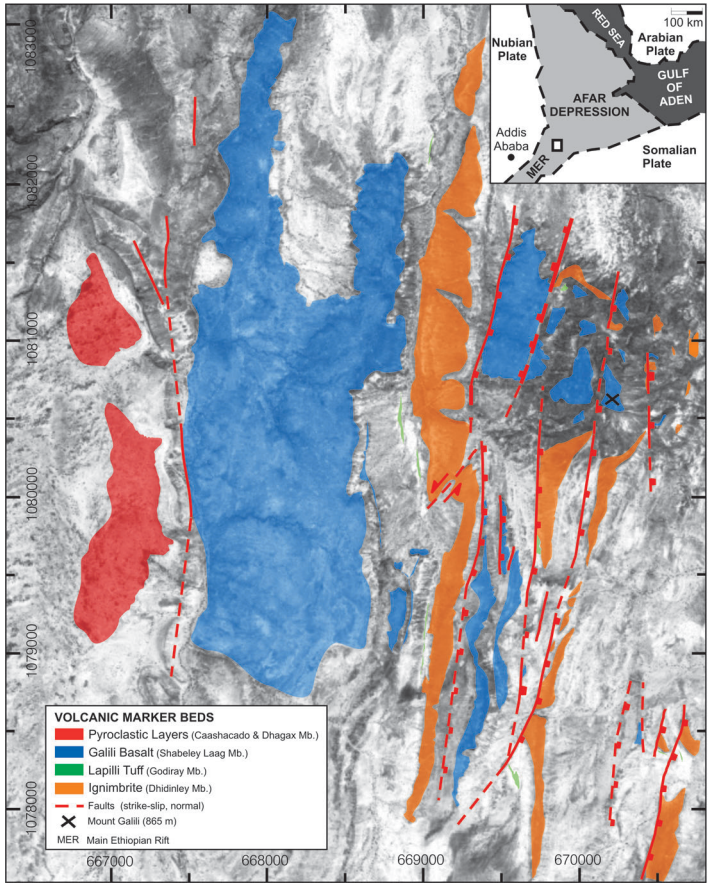
2. Sedimentological and paleoenvironmental studies in Pliocene hominid-bearing deposits of the Mount Galili Formation

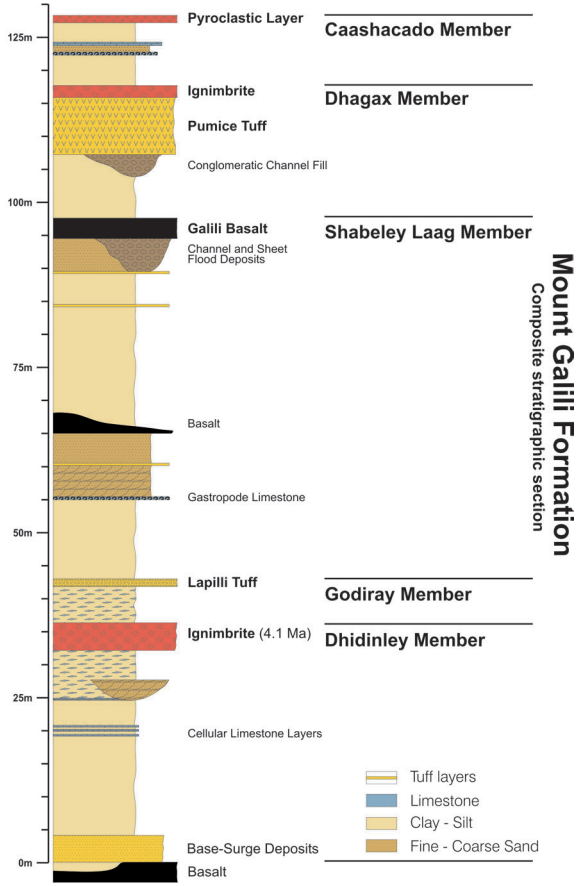
The Mount Galili Fm. (Fig. 1) represents a succession of fluvio-lacustrine sediments with several horizons of volcanics. Typically the sedimentary cycles end up with volcanic layers at the top of each member. Facies analysis is preliminarily based on 21 lithostratigraphic sections using the volcanic layers as marker beds for correlation. The Mount Galili Fm. comprises five different types of volcanic rocks representative for each member:

1. At the top of the Dhidinley Member a well developed ignimbrite up to 5 m thick covers a sedimentary sequence of silty and clayey sediments, thin limestone beds and fluvial sands.

2. The Godiray Member is defined by a bright white, coarse-grained Lapilli Tuff up to 1 m thickness and 5 m of undifferentiated silty to clayey sediments below.

Fig. 1: Geological sketch map and stratigraphic section in the center of the PAR excavation area with the main volcanic marker beds used for member subdivision of the Mount Galili Fm. (composite stratigraphic section). Map is based on Ikonos and LandSat TM7 satellite images. Location of the excavation area (white rectangle) at the transition between the northernmost segment of the Main Ethiopian Rift (MER) and the southern Afar Depression.
Abb. 1: Geologische Übersichtskarte und stratigraphisches Profil im Zentrum des PAR Grabungsgebietes mit den wichtigsten vulkanischen Leithorizonten, die für die Einteilung der Mount Galili-Fm. in Subformationen dienen. Kartengrundlage sind Ikonos und LandSat TM7 Satellitenbilder. Das Grabungsgebiet (weißes Rechteck) liegt am Übergang des nördlichsten Teils des Äthiopischen Hauptrifts (MER) zur südlichen Afarsenke.


100 km
Nubian Plate
RED SEA
Arabian Plate
GULF OF ADEN
AFAR DEPRESSION
Addis Ababa
MER
Somalian Plate
1083000
1082000
1081000
1080000
1079000
1078000
667000
668000
669000
670000
VOLCANIC MARKER BEDS
Pyroclastic Layers (Caashacado & Dhagax Mb.)
Galili Basalt (Shabeley Laag Mb.)
Lapilli Tuff (Godiray Mb.)
Ignimbrite (Dhidinley Mb.)
Faults (strike-slip, normal)
Mount Galili (865 m)
MER Main Ethiopian Rift


125m
100m
75m
50m
25m
0m
Pyroclastic Layer
Caashacado Member
Ignimbrite
Dhagax Member
Pumice Tuff
Conglomeratic Channel Fill
Galili Basalt
Shabeley Laag Member
Channel and Sheet Flood Deposits
Basalt
Gastropode Limestone
Lapilli Tuff
Godiray Member
Ignimbrite (4.1 Ma)
Dhidinley Member
Cellular Limestone Layers
Base-Surge Deposits
Basalt
Tuff layers
Limestone
Clay - Silt
Fine - Coarse Sand
Mount Galili Formation
Composite stratigraphic section

3. The sedimentary successions of the Shabeley Laag Member vary in thickness and grain size distribution but always end up with 3–5 m thick basaltic lava flows at the top.

4. The Dhagax Member is clearly dominated by volcanic activity producing a 10 m thick pumice tuff ending up in a thin grey to reddish ignimbrite layer.

5. The Caashacado Member defines the uppermost part of the Mount Galili Fm. comprising a gastropod-bearing limestone horizon and ending up with a thin pyroclastic layer on top.

Two major facies are present in the Mount Galili Fm., interpreted as lacustrine and fluvial environments. The whole formation seems to represent a relatively short accumulation time span based on biostratigraphic markers like suids and elephants. The sedimentary development was affected by interruptions of large volcanic events. In the Dhidinley and Shabeley Laag Mb. a conspicuous facies trend from silty-clayey lake sediments with single limestone beds to coarse fluvial sands has been observed. It is thought that these regressional trends are controlled by surface uplifts due to tectonomagmatic processes.

The lacustrine deposits are characterized by multi-coloured, clayey sediments with abundant fossil remains of fishes, turtles and crocodiles, thin limestone beds, diatomite horizons and grey, gypsum-bearing clayey sediments. The extended gastropod-bearing limestone horizons of the Shabeley Laag and Caashacado Mb. represent a nearshore facies predominantly composed of casts from *Bellamya* (Jousseaume, 1886), *Melanoides* (Olivier, 1804) or *Cleopatra* (Troschel, 1857). Fish remains, such as *Barbus* Cuvier & Cloquet, 1816 and *Clarias* Gronow, 1763 are also well known from recent lakes and oxbow lakes. It seems that changes in the water level of the lake also influenced salinity. Diatomite horizons especially represent water highstands. Mud flats deposited at nearshore areas under the terrigenous influence of river mouth or alluvial fans are composed of grey to brownish silty deposits with thin sand intercalations.

The fluvial deposits are characterized by sandy channel-fill sequences cutting into the lacustrine facies. Such channel-fill deposits are present in the exposures of the Dhidinley and Shabeley Laag Mb. Both consist of grey to bluish, cross-bedded and feldspar bearing sands indicating current directions towards the N and E. Such sands, which were preferentially deposited in fluvial channels with a permanent current strong enough to keep the suspension load in motion, show well to moderate sorting and symmetrical to positive skewness (Fig. 2). Sediments from channels with weaker current conditions are marked by a higher content of the suspension fraction documented by a pronounced fine tail of their cumulative curve.

Evidence for periodically dry parts of the fluvial system comes from sheet flood deposits. Sedimentary reworking and mixing processes shown in stream bars (gravel to sand) and flood plain sediments (fine fraction) explain their bimodal and polymodal

grain size distributions. Sheet flood deposits are mainly observed in the central area of the Shabeley Laag Mb., immediately below the Galili Basalt, where findings of primate and hominid teeth have been made. Flood plain deposits predominantly consist of grey to brownish fine sands and silts with lots of rhizolitic structures.

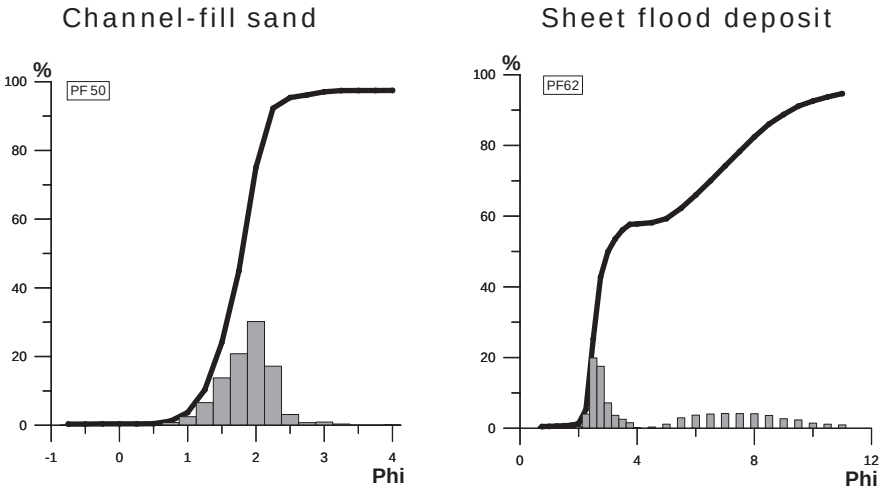


Fig. 2: Left: Channel-fill sand from the Shabeley Laag Mb., below lower Galili Basalt. Right: Sheet flood deposit that shows mixing of channel sands and interchannel sediments from the Shabeley Laag Mb., below upper Galili Basalt, at the so called "Primate site". Grain size analysis by combination of MacroGranometer™ and Sedigraph™ methods.
Abb. 2: Links: Channel-fill Sande der Shabeley Laag-SbFm. (unterhalb des unteren Galili Basalts); Rechts: Sheet flood Ablagerungen zeigt eine Durchmischung von channel sands und zwischengelagerten Sedimenten der Shabeley Laag-SbFm. (unterhalb des oberen Galili Basalts) an der sogenannten „Primate site". Korngrößenanalysen wurden durch eine Kombination von Methoden am MacroGranometer™ und Sedigraph™ durchgeführt.

Preliminary $\delta^{18}O$ and $\delta^{13}C$ [V-PDB] data from pedogenic carbonates of the thin Godiray Mb. are in good agreement with published data from the Lower Pliocene of the region to the west of the Awash River (Haile-Selassie et al. 2004). The $\delta^{13}C$ values also compare well with those from Gona (Ethiopia), which point to a woodland and grassy woodland (Levin et al. 2004).

During lake regressions more attractive conditions for large mammals, e.g. elephantoides, suids, bovides and large carnivores were created. The sedimentary record and abundance of fossils show that the environment of the Shabeley Laag Mb. provided better conditions for a rich wildlife than other members. The fluvial sands exposed below the Galili Basalt have high abundance of large mammal remains. This has not been found so far in the fluvial sands of the Dhidinley Mb.

In general, the fauna of the Mount Galili Fm. represents a Pliocene landscape of woods and grassy woodland with river and lake systems and seasonal dry periods. The hominid remains from Galili do not contradict the assumptions of REED (1997), who classified the habitats of *Australopithecus afarensis* (JOHANSON, 1978) as close to open woodland-bushland with edaphic grasslands.

3. Petrological data of volcanic marker beds

The main volcanic horizons occurring in the stratigraphic successions of the Mount Galili Fm. serve as characteristic marker beds with different lithologies: basalts, ignimbrites, pumice and lapilli tuffs. The geochemical investigations were mainly concentrated on the classification of the basaltic marker beds comprising main, trace and rare earth element analysis. In the Total Alkali Silica (TAS) diagram, the basalts plot in between the picrobasaltic and basaltic field typical for a continental rift.

Volcanic fragments from a 4 m thick ignimbrite layer on top of the Dhidinley Mb. vary, at high alkali levels (7–9 %), from trachytic to dacitic and rhyolitic composition, whereas at low alkali contents (<7 %) they plot in the andesitic field. This ignimbrite forms the most significant acid volcanic marker bed within the investigation area.

The basaltic lava flows that are from different stratigraphic positions have SiO_2 contents ranging between 43.7–46.3 wt-% and total alkalies between 2.6–3.5 wt-%. In the TAS diagram they plot in the fields of basanites and basalts. Trace element distributions (Zr/Y-Zr; Ti/100-Y*3-Zr) show typical "Within Plate" signatures with OIB (ocean island basalts) affinities.

Mantle-normalized incompatible trace element patterns (Fig. 3) allow the division of the basalts into three groups: Group 1 is characterized by a strong positive Ba and a weak positive Nb anomaly. Group 2 shows, in addition to Ba and Nb, also a positive Sr anomaly. Group 3 is similar to Group 1 but is markedly less enriched in incompatible elements. In addition, the mantle-normalized rare earth element (REE) patterns of Group 1 and 2 are relatively steep ($La_N/Yb_N = 5–7$), in contrast to Group 3, suggesting garnet in the residue.

Intitial $^{87}Sr/^{86}Sr$ and $^{143}Nd/^{144}Nd$ ratios vary from 0.703713 to 0.704887 and from 0.512817 to 0.512899 respectively (Fig. 4). Lavas with the most depleted radiogenic isotopes correspond to Group 3 lavas, which show the lowest enrichment in incompatible elements at the MORB-OIB transition. Furthermore, the isotopic ratios in combination with the high Ti/Yb and the low K/P ratios suggest rather heterogeneous magmatic sources and no crustal contamination.

All basalts from these 3 groups show a positive Ba anomaly that is decoupled from the behaviour of the other incompatible elements, probably attributable to an ancient subducted slab.

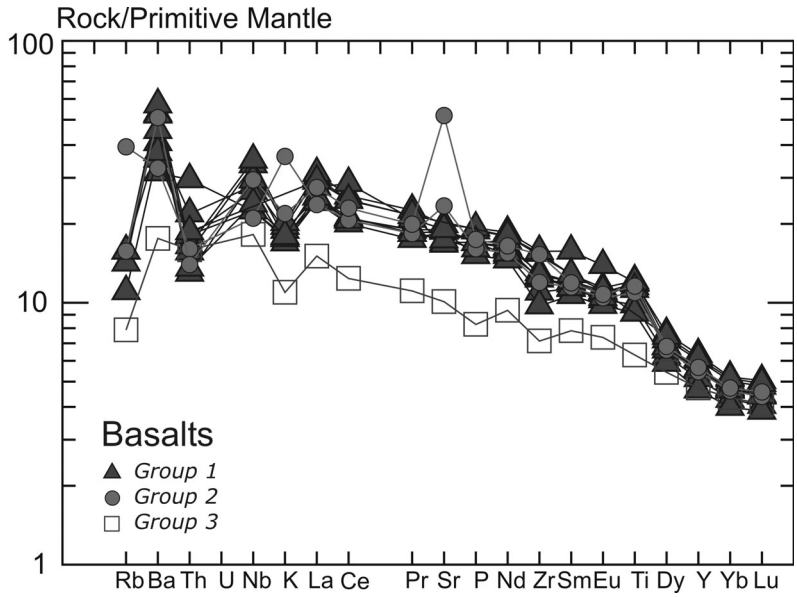


Fig. 3: Mantle-normalized incompatible trace element patterns (after SUN & MCDONOUGH 1989) allow the division into three groups of the main basalt horizons. Rare earth and trace element analysis by Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) and X-ray fluorescence (XRF) method.
Abb. 3: Mantelnormierte Verteilung der inkompatiblen Spurenelemente (nach SUN & MCDONOUGH 1989) erlaubt eine Unterteilung der wichtigsten Basalthorizonte in drei Gruppen. Analysen der Seltenerdelemente und der Spurenelemente wurden mit ICP-MS (Inductively Coupled Plasma-Mass Spectrometry) und der Röntgenfluoreszenzmethode durchgeführt.

Field observations from geological mapping, isotopic and geochemical data show that the youngest basaltic lavas have a MORB-like signature (Group 3) and the older lavas an OIB-like composition (Group 1, 2) which is consistent with the aulacogen nature of the East African Rift. The basalts of the Mount Galili Fm. highlight the magmatotectonic setting of the excavation area in the transition zone between continental and oceanic rifting.

4. The Fauna of the Mount Galili Formation

Beside abundant crocodile, turtle and fish remains, the majority of the collected fossils belong to large terrestrial mammals, whereas micro-mammals are still lacking. Several mammalian taxa (Tab. 1) have been recovered in the sedimentary deposits at Galili, were hitherto unknown from the Ethiopian Somali Region.

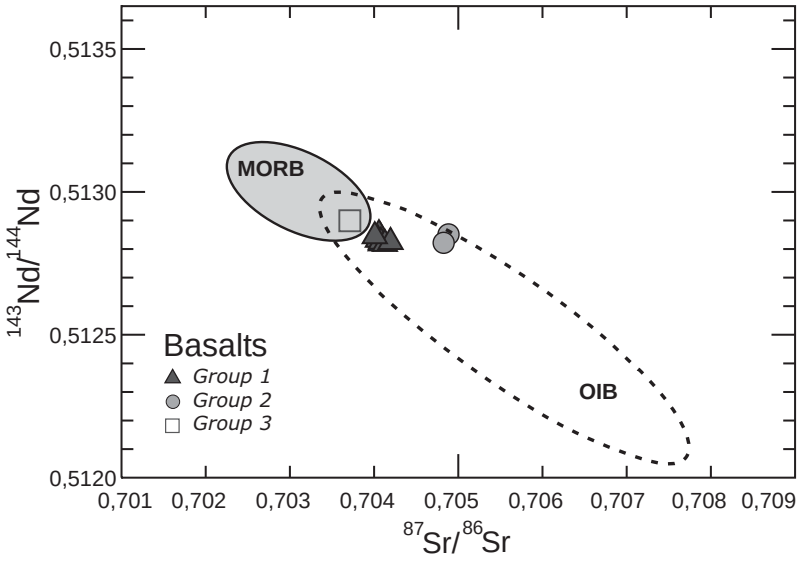


Fig. 4: Sr and Nd isotope ratio correlations for the basalts with MORB-like signature (Group 3) and an OIB-like composition (Group 1, 2). MORB and OIB fields after ROLLINSON (1993).
Abb. 4: Sr und Nd Isotopenverhältnisse für Basalte mit MORB-nahen Signaturen (Gruppe 3) und OIB-nahen Zusammensetzungen (Gruppe 1, 2). MORB und OIB Felder nach ROLLINSON (1993).

These fossils include specimens that can be allocated to 13 mammalian families: Bovidae, Giraffidae, Hippopotamidae, Suidae, Rhinocerotidae, Equidae, Hyaenidae, Felidae, Elephantidae, Deinotheriidae, Gomphotheriidae. Primate remains consist of Hominidae and Cercopithecidae.

The fossil assemblage consists of fragmentary postcranial and cranial remains. High density of elements like teeth, jaws, long bone fragments and footbones prevail. The taphonomic history of the assemblage included modification after deposition. This effected the size distribution, the frequencies of skeletal elements and the taxonomic composition.

The fauna is dominated by large mammals, essentially bovids. The majority of the bovid fauna consists of Tragelaphini and Aepycerotini, tribes that are adapted to a closed habitat. The scarcity of alcelaphines and antilopines especially, is striking.

Molar fragments of *Elephas recki* ssp. (BEDEN, 1980) specimens (BEHRENSMEYER et al. 1997) are the most common elephant elements. Remains of *Anancus* sp. and *Deinotherium* aff. *bozasi* (BEHRENSMEYER, TODD, POTTS & MCBRINN, 1997) found at Lake Turkana/Kenya date back to 4.1 Ma.

The suid fauna is dominated by *Nyanzachoerus kanamensis* (COOKE, 1978), also indicating a denser vegetation in the surrounding of the ancient lakes and rivers. The occurrence of a few suid remains attributable to the Notochoerine tooth type resembles

a transitional stage between *Nyanzachoerus jaegeri* (Cooke, 1978) and *Notochoerus euilus* (Cooke, 1978). These specimens show elongated and higher molars (M3) as *N. kanamensis* and therefore may indicate an environmental change towards drier conditions and less vegetation cover, which is in agreement with preliminary stable isotope data.

Pisces
- Cyprinidae
  - *Barbus* sp.
- Clariidae
  - *Clarias* sp.

Reptilia
- Testudinata indet.
- Crocodylia
  - *Crocodylus* cf. *niloticus*

Aves
- Aves indet.

Mammalia

Primates
- Hominidae
  - cf. *Australopithecus afarensis*
- Cercopithecidae
  - *Theropithecus* sp.
  - aff. *Parapapio ado*
  - Colobinae indet.

Carnivora
- Viverridae indet.
- Felidae
  - *Homotherium* cf. *crenatidens*
  - *Dinofelis* sp.
- Hyaenidae
  - *Chasmaporthetes* sp.

Proboscidea
- Deinotheriidae
  - *Deinotherium bozasi*
- Gomphotheriidae
  - *Anacus kenyensis*
- Elephantidae
  - aff. *Stegotetrabelodon orbus*
  - *Loxodonta* sp.
  - *Elephas recki* ssp.

Perissodactyla
- Equidae
  - *Eurygnathohippus* sp.
  - *Equus* sp.
- Rhinocerotidae
  - *Diceros bicornis*

Artiodactyla
- Suidae
  - *Nyanzachoerus jaegeri*
  - *Nyanzachoerus kanamensis*
  - *Notochoerus euilus*
  - *Notochoerus* sp.
  - *Kolpochoerus afarensis*
  - *Metridiochoerus* sp.
  - *Phacochoerus aethiopicus*
- Hippopotamidae
  - *Hexaprotodon* sp.
  - *Hippopotamus* sp.
- Giraffidae
  - *Sivatherium* sp.
  - cf. *Giraffa stillei*
  - cf. *Giraffa pygmaeus*
  - *Giraffa* sp.
- Bovidae
  - *Damaliscus* sp.
  - *Parmularius* sp.
  - Alcelaphini indet.
  - *Hippotragus gigas*
  - *Hippotragus* sp.
  - *Menelikia lyrocera*
  - Reduncini indet.
  - *Gazella* sp.
  - Neotragini indet.
  - aff. *Tragelaphus kyaloae*
  - aff. *Tragelaphus nakuae*
  - *Tragelaphus* sp.
  - *Ugandax gautieri*
  - *Aepyceros* sp.

Tab. 1: Preliminary faunal list of large mammals from Galili excavation area.
Tab. 1: Vorläufige Faunenliste der Großsäuger aus der Galili Grabungsstätte.

4.1. Hominid remains of the Galili area

The surveying and the excavations at the Plio-/ Pleistocene deposits of the Galili area yielded several hominid findings, comprising four isolated teeth from different localities and one postcranial element (clavicula). The teeth are all molars, one preserved as a complete crown with distal roots (GLL 33, lower right third molar), two as complete crowns (GLL 555, lower right third molar germ; GLL 747, slightly worn upper right second or third molar), and one as a crown fragment (GLL 610, lower molar) with relatively thick enamel. The latter three teeth were only documented in the field and need more analysis but first measurements indicate that size and proportions fall well within the known variation of both *A. afarensis* and *Australopithecus anamensis* (Leakey, 1995). The fact that crown morphology also overlaps between these two species shows the difficulties of attributing isolated teeth to species. So far, only GLL 33, found in the first year of field activities at Galili, was studied in more detail and published (Macchiarelli et al. 2004). Analysis show that this tooth likely represents a male individual of advanced age-at-death. Its comparative metrical, morphological and (micro-)structural analysis (supported by a microtomographic record) suggests a tentative taxonomic allocation to *Australopithecus* cf. *A. afarensis*.

Only one tentative hominid postcranial element (GLL 520) was found during in situ excavations. This extraordinarily fragile specimen needs further preparation but on-site notes and photographs in the field suggest that it could represent a fairly complete clavicula from hominid provenance.

4.2. Comparative studies of Cercopithecidae

Comparative study of the cercopithecoid fossils recovered in the field seasons 2000–2004 allows conclusions regarding the taxa present at Galili. In the dental samples, three different taxa can be distinguished, one colobine and two cercopithecines. We can differentiate at least three different morphs in the dental sample. The first is characterized by rather thin enamel, high cusps and acute para- and metalophs, these teeth are also smaller than the other two morphs. The three teeth of morph 1 clearly represent a colobine, but as the dental morphology of colobines is very uniform, their exact affinities are hard to determine. Metrically the teeth are most similar to *Colobinae* sp. A from the Omo succession (sensu Eck 1976). More remains are needed for a more accurate interpretation.

Morph 2 is characterized by relatively low-crowned teeth, with blunt, rounded cusps, and a relatively thick enamel. These teeth represent a papionine, *Parapapio ado* (Hopwood, 1936), known from Laetoli, that is relatively similar in both size and shape. GLL 379, a partial cranium, belongs to this taxon. Once finally prepared, it will allow a much better understanding of the phylogenetic status and the functional adaptations of this morph.

Only a few teeth represent the third morph. These seem to be cercopithecine, but with higher crowns and relatively pinched cusps. They are also somewhat larger as morph 2. This form is probably an early member of the *Theropithecus* (Szalay & Delson, 1979) radiation, one of the earliest occurrences of this genus. The postcranial evidence also seems to indicate more than one taxon, the five proximal ulnae discovered show a size variance higher than that expected for a single taxon.

Acknowledgements

This research was funded by the Austrian Council for Science and Technology, the Austrian Ministry for Education, Science and Culture GZ 200.049/3-VI/I/2001, AD 387/25-30, GZ 200.093/I/VI/2004 and the Austrian Science Fund (FWF) P15196-GEO. We express our gratitude to Ethiopia, for its generosity to allow us to participate in the research dealing with the cultural heritage of this wonderful country. Many thanks to the Authority for Research and Conservation of Cultural Heritage (ARCCH) and especially Ato Jara Haile Mariam and his team, the director of the National Museum Mamito and her team, to Ato Getu, our antiquity officer, and all the people of the Somali Region that supported us. Special thanks to Mike Edwards for corrections to the english manuscript.

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