What are Oldowan 'favoured places' and what do they tell us about hominin behaviour..?

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1. Introduction

The Oldowan defines one of the most significant periods of human evolution. Hominins, with large-bodies and large-brains, developed social-structures and a material-culture which evolved them into the species we are today.

This distant time-period originated in the East African Rift Valley 2.6 million years ago (mya), radiated into South Africa by 2.0-mya and North Africa by 1.8-mya [*Figure-1.1, 1.2]*(Schick and Toth 2006:9).

There are a number of prevailing interpretations of our early ancestors and one critical theory focuses on whether hominins where hunter-gatherers, with social-groupings, or opportunistic-scavengers (Pirie 2007:4-5).

Fossil evidence suggests that early hominins evolved through different phases of adaptive radiation [diversification from a single ancestral-stock]. Adaptations include climatic-change, partial bipedalism, efficient teeth/jaws, scavenging and tool-use - which by chance triggered their evolution into a successful and wide-spread species (Lewin and Foley 2004:323-324).

The discovery of contemporaneous hominin remains, manufactured-tools and evidence of butchery has revealed a watershed in the emergence of humanity (Isaac 2009:221). Archaeological evidence is used to assess the abilities of hominin tool-users in relation to their behaviours and cognitive capabilities and the patterns of natural selection that were initiated during this period. If we can demonstrate that Oldowan favoured-places (also-known-as home-bases or camps) existed then we may assign early hominins human-like characteristics - alternatively if favoured-places are random collections of debris we must characterize the hominins as non-humans.

2. The Oldowan

Africa, the cradle of mankind

Archaeology suggests that during the Lower-Palaeolithic hominins grouped together in small societies, using stone-knapping for tool-manufacture and hunting-gathering or opportunistic-scavenging. Humankind gradually evolved into modern humans (*Homo sapiens*).

What is 'Oldowan'

Louis Leakey began searching for evidence of early humans in Africa in the 1920s and in 1936 described pre-Acheulean material from the Kenya's Olduvai Gorge as Oldowan (Schick and Toth 2006:3-4).

The Oldowan is a period-of-time where the earliest traces of material-culture are found, it typically relates to Africa but has been used for Eurasian sites. The Oldowan is characterized by flakes and battered tools with conchoidal percussion fractures made from simple cores - typically rounded river cobbles or pebbles.

Mary Leakey sub-divided the Oldowan, using tool developments, into four distinct industries; they were Oldowan (1.85-mya), Developed Oldowan A (1.65-mya), Developed Oldowan B (1.1-mya) and Early Acheulean (1.5-mya). Isaac, in 1976, 'gathered' the Oldowan industries into the Oldowan Industrial Complex.

During the 1960s/1970s other Oldowan sites were discovered in Africa and, currently, the earliest site is Gona [Ethiopia] which dates to approximately 2.6-mya. The Oldowan period's end is imprecise; it isn't typically used after 1.1-mya and Schick and Toth suggest 1.4-mya.

Olduvai Gorge

Extant evidence of early humans was found by Mary Leakey in the Olduvai Gorge at 11:00 on 17th July 1959 when she discovered the upper-part of a fossilized skull [*Figure-2.1, 2.2*](Leakey 1967:xv). It was classified as *Zinjanthropus boisei* and later reclassified as *Australopithecus boisei*.

During the following 2-years remains of *Homo habilis* were found. *Homo habilis* and *Australopithecus boisei* are contemporaneous and it is thought, based on physical characteristics, that *H. habilis* was probably the tool-maker (Stringer and Andrews 2008:71). The *Australopithecus boisei* skull was dated to 1.75-mya using Potassium-argon ($^{40}K/^{40}Ar$) dating, which is suitable for dating volcanic deposits between 1 and 5-mya (Aston 2009:168).

The Palaeolithic had been regarded as an unpromising time-period for understanding human evolution (Gamble and Porr 2005:1) but since Mary Leakey's discoveries, within Bed I and II, the early hominins have been placed within a spatial and chronological context (Schick and Toth 2006:34-35).

Taxa

Excavations at Olduvai places both *Australopithecus boisei* and *Homo habilis* within the Oldowan and, as Pirie (2007:2) observes, a number of gracile and robust species coexisted in Africa during the Oldowan - although inter-species relationships are a matter of 'much debate'.

The following taxa were contemporaneous to the Oldowan (Schick and Toth 2006:18):

Australopithecus garhi
Australopithecus aethiopicus
Australopithecus boisei
Australopithecus robustus
Homo habilis
Homo rudolfensis
Homo ergaster/erectus

In the 1970s it was thought that species could not coexist but Bilsborough (2009:215) argues that coexistence was possible within a spatially-large and population-low environment.

Oldowan hominins where relatively small-brained, probably didn't process fire or complex weapons and they shared their environment with large carnivores. The threat from day-to-day living was intense (Shipman 1986:37).

Climate and Environment

Between 3.0-2.0-mya global climate-change resulted in parts of Africa becoming cooler and dryer which encouraged the spread of grass-land and savannah (Schick and Toth 2006:9). Periods of tectonic uplifting also played a role in altering rainfall-patterns and Africa's aridification [*Figure-2.3*]. Deep-Sea cores, between 2.0-1.0-mya, provide evidence of climatic change between glacial and interglacial periods (approximately every 41,000 years) which was caused by cyclical shifts in the earth's axis [*Figure-3*] (Barham and Mitchell 2008:45,162).

Climatic change resulted in a mosaic of open and variable habitats which were impacted by seasonal variations and extended periods of drought [*Figure-4*](Barham and Mitchell 2008:45).

Oldowan sites are typically found in riverine and lacustrine contexts, such as flood-plains, deltas and lake margins. Sterkfontein, for example, provided an environment with a source of drinking water, open grassland and riparian woodlands - determined from fossil wood, stable isotope evidence and micro-mammal analysis (O'Regan and Reynolds 2009:216). In summary a forest fringe environment equivalent to today's tropical forests.

Impact on hominin population cannot be assigned directly to a changing environment but it is probably an evolutionary factor and Oldowan Mode-1 tool-users are placed within this context.

3. **Favoured-Place**

Archaeological sites, which are exceptionally rare, have demonstrated that crude lithic tools were manufactured and used for butchery (Pirie 2007:4). Archaeological evidence includes (Isaac 2009:224, Schick 1987:790):

- sparse-scatters or denser-clusters of remains
- flaked stones, debitage and manuports
- mammalian remains, typically teeth and broken bones, from different taxa - some with cut-marks from stone-tools [*Figure-5*]
- raw-material transported from one or more locations (which suggests either a number-of-trips or a number-of-visits)

Sites may have been formed during short-periods of temporary use or long-periods of occupation when hominins returned over-and-over again. Stern (1993:209,215) explained that, although taphonomic studies have determined that fossilized bones were buried within 6-15 years, the materials could have been deposited over time-spans of up-to 100,000 years. Land-surfaces were 'sealed' relatively quickly by volcanic ash/lava preserving the remains within a time-slice of the paleolandscape (Hallos 2005:158).

Sites with denser-clusters of remains are interpreted, by some archaeologists, as favoured-places. An alternative theory is that denser-clusters are the result of randomly gathered accumulations, for example by environmental or fluvial processes although Sept et al (1992:188) believe that water-transport has been eliminated as a factor in stone accumulation.

Potential uses of Favoured-places include:

- food-processing and eating/drinking
- tool-manufacture
- sleeping
- rearing of young
- protection
- social-interaction
- location where hunter-gatherers and opportunistic-scavengers returned-to

Leakey (1971:262) theorised that hominins used camps as a place-of-refuge, protecting them with defensive thorn-fences and building crude-shelters. South African sites have been found within limestone caves although, as Schick and Toth (2006:9) remark they may have been carnivore dens. However, the archaeological record cannot support Leakey's proposal and we

must guard against associating modern hunter-gather characteristics with hominins - Stern (1993:215) warned against cleaning-up data to look 'like a series of mini-Pompeiis'.

In 1971 Mary Leakey (1971:258), from her excavations of occupation-floors (high-concentration of materials), divided sites into Living Floors (interpreted as camp sites), Kill Sites (animal butchery), Scatters (vertically diffused material) and Fluvial (materials within riverine gravel deposits). Isaac (1989a:278) extended this by classifying sites by stone-artefacts:

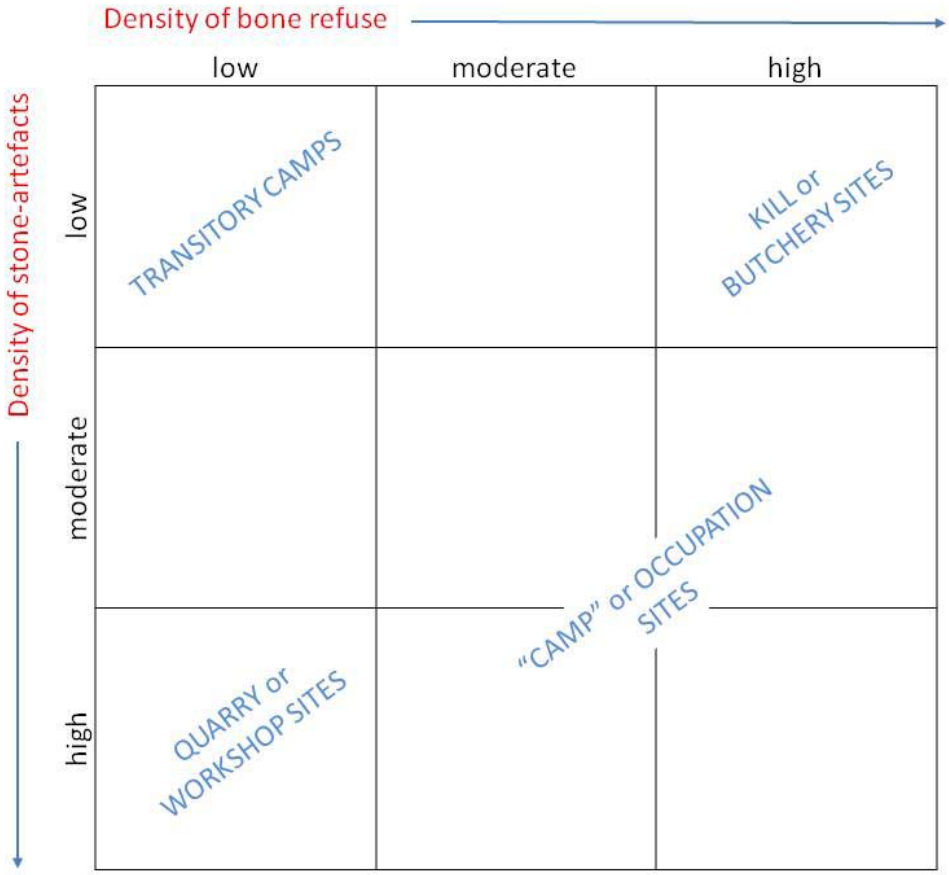


Table-1: Site Classification Matrix (after Isaac 1989a:278)

4. **Hominin Behaviours**

Oldowan Culture

Bipedalism

There is unambiguous fossil evidence, from the footprints of an adult and two younger bipedal hominins left in volcanic carbonatite ash [*Figure-6*], that by 3.76-mya some hominins were bipedal (Tomkins 1998:65). The hominins may have spent 40% of their lives in trees (Lewin and Foley 2004:252) but an evolution to a terrestrial way-of-life in an savannah environment suggests that a level of dependency on bipedalism was necessary (Schick 1987:792-793).

Bipedalism necessitated/resulted-in morphological adaptations (Tomkins 1998:63-64) including changes to the spinal-column and vertebrae, ribs, humerus/ulna, pelvis, femur/tibia, knee, foot/phalanges, muscles and tendons. Overall; a radical structural and physiological metamorphosis had occurred by the end of the Oldowan.

Bipedalism is thought to be the ‘primary hominin adaptation’ which resulted in ‘adaptive radiation in the Pliocene’ (Lewin and Foley 2004:241-242,253). The key factor is that it 'frees the hands and arms for other activities than locomotion' such as running while carrying implements and throwing (Osvath and Gärdenfors 2005:4-5).

Physical Development

Generally *Australopithecus* had small-brains, large-teeth (some with enlarged chewing-muscles facilitated by sagittal cresting); *Homo* species had larger-brains and smaller-teeth (Barham and Mitchell 2008:101). Isaac (2009:223) thought it probable that morphological adaptations and tool-making were coeval .

There is ongoing debate into Oldowan taxa; *Homo ergaster/erectus*' morphological adaptations represent successful evolutions (Osvath and Gärdenfors 2005:7-8). These include longer-legs, shorter-arms and broader-torso which created a physical-framework that could move quickly, efficiently and over long-distances while retaining fluids by cooling through sweating (Plummer 2004:127). These traits would suit both opportunistic-scavengers and hunter-gatherers who travelled long-distances or expend 'bursts' of energy.

Homo brain-sizes increased, teeth and jaw-sizes dropped dramatically (Osvath and Gärdenfors 2005:8) and large chewing-muscles developed (Barham and Mitchell 2008:102) indicating a 'shift toward high-quality foods requiring less oral preparation' (Plummer 2004:126-127,148). Importantly increased cognitive skills increased the chances-of-survival (Tomkins 1998:86).

Plummer explains that the human brain metabolism consumes 20–25% of adult energy - unsurprisingly a high-quality diet is a human characteristic. Actualistic studies suggest that morphological adaptations required an energy increase of between 40–45% and 80–85% which was 'fuelled' by diet, an energy-efficient gut and muscle reductions.

Cognition

The use of stones as tools are likely to pre-date the Oldowan - even some birds can use stones as tools. The ability to plan-in-advance, which Osvath and Gärdenfors (2005:1) describe as 'anticipatory-cognition', is the differentiator between *Homo sapiens* and primates and is a catalyst which evolved hominins into 'thinking humans.' Hallos (2005:156-158) reiterate that ‘we are planning agents ... [within] our cognitive resources' - we plan and then execute/adjust. This is a fundamental human trait.

Schick and Toth (1993:126-127), Harmand (2009:1605) agrees, noticed that hominins, at Koobi Fora, were fairly unselective in the raw-material employed. I do not consider the raw-material of disposable primitive tools to be critical - as Osvath and Gärdenfors (2005:1) say this is an early phase of cognitive development and through anticipatory-cognition it spanned tool-manufacture, co-operating social-groupings, and symbolic-communication.

Of course it is speculative to suggest symbolic-communication (which could range from screeches or gestures to limited conversation) during the Oldowan but at some point this cognitive skill became speech. The level of cognition during the Oldowan is unknown but, along with other behaviours, it represents the Oldowan Culture.

Hunter-Gatherers or Opportunistic-Scavengers

My definition of opportunistic-scavengers is hominins who survived by taking opportunities as they happened but not making the opportunities happen whereas hunter-gatherers exercised some control over the environment by exploiting animals. Both style of substance would have taken advantage of resources such as tubers, fish and tortoises and it's likely that opportunistic-scavenging was also used by hunter-gatherers when expedient.

Archaeological excavations recover most material from 'Occupation Floors', especially at Olduvai and Koobi Fora, and actualistic-studies are employed to interpret the prehistoric record. Differences in opinion have developed into two primary views; hunter-gatherers (favoured-places/bases) or opportunistic-scavengers (temporary processing-sites):

Hunter-gatherers

Isaac (1989c:333-4) interpreted these as places as home-bases, and later as central-place-foraging [*Figure-7*], where food was shared by social-groups using a division-of-labour between hunter/male and gatherers/female.

Potts (1988:278-279) agreed with home-bases and proposed that they were also used as stone-caches where hominins transported suitable stones for later use – I suggest that this is tenuous because of the level of advanced planning required, Potts (1988:281) acknowledged this issue, and the unpredictable migratory patterns of prey. It is equally possible that stone-transport resulted from hominins carrying stones from place-to-place as weapons.

Opportunistic-scavengers

Binford (Schick and Toth 2006:20) rejected food-sharing and division-of-labour and interpreted sites as locations where felid carnivores consumed their prey and hominins scavenged from. Binford revised his view by proposing that hominins stripped/processed carcasses at sites having scavenged from other locations. Blumenschine (Schick and Toth 2006:20) supplemented Binford's theory and proposed that opportunistic-scavenging was more likely during the dry-season and, therefore, the archaeological evidence was unrepresentative of hominin behaviours during the rainy-season.

Adaptive and Reactive

Current trends have moved from hunter-gatherers to opportunistic-scavengers and back to hunter-gatherers. Future analysis, possibly using stable isotopes, may be able to distinguish scavenging from hunting (Borrero 2008:1478).

Theories are divided into two opposing views; reality is rarely so binary. The Oldowan spans at least one million years - a period when significant human evolution and cognitive changes occurred and within a large geographic area - I believe it probable that both hunter-gathering and opportunistic-scavenging were regular practices for hominins as they adapted and reacted to their environment.

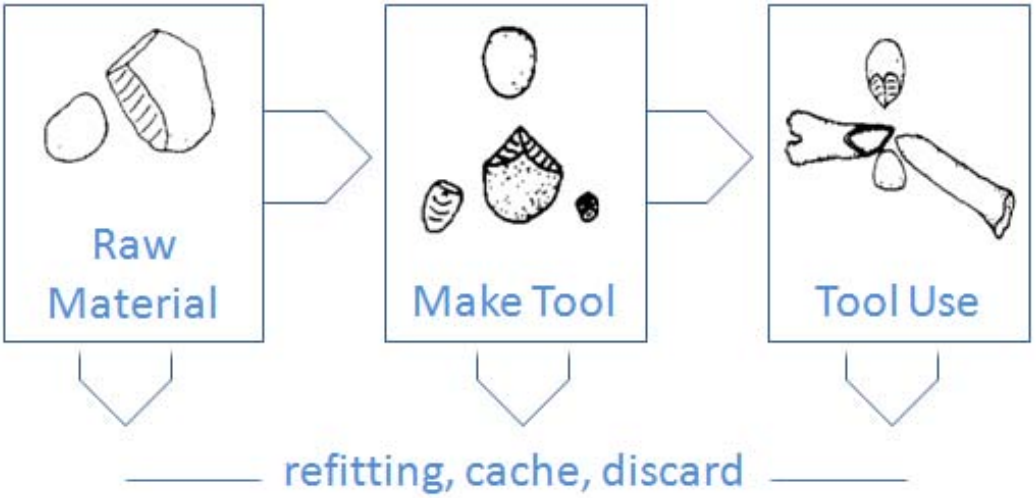
A pivotal argument for/against home-bases is felid carnivore's attraction to a location with 'meaty carcases' (Rose and Marshall 1996:315). I suggest that the season (fluctuating food availability) and hominin's defensive capabilities are factors which

negate this argument. Overall I believe that favoured-places existed but not as settled 'homes' and that their use was within a nomadic and seasonal existence.

Tool-Manufacture and Adaptation

Stone-tools are classified into 5-categories and Mode-1 (representing simple chopping tools made from cobbles) defines Oldowan tools and, in Africa, date from 2.6-mya. Mode-1 tools were found in Olduvai Beds I and II (dating between 1.9-1.6-mya) and Mary Leakey classified these as tools, utilized pieces, waste and manuports. Mode-1 utilizes local cobbles; a variety of raw materials and sizes are found in different archaeological sites.

Hominins' ability to manufacture practical tools from raw-materials represents a technological revolution (Lewin and Foley 2004:309-315) and hominins had mastered percussion stone-knapping. Schick and Toth (1993:118-119,128-129) explain primitive stone-tools could have been manufactured by percussion, anvil (striking a stone against a larger stone) and/or throwing techniques - or from reusing naturally flaked stones - and the objective may have been sharp-edged flakes rather than cores.



Stone-Tool Model (based on Schick 1987:799)

Raw-materials, for example at Olduvai Bed I, were transported up-to 10km (15-20km at Koobi Fora (Osvath and Gärdenfors 2005:6)) before being manufacture into stone-tools [*Figure-8*](Sept et al 1998:188). de la Torre and Mora (2005:283-284) propose that most manuports [unmodified cores] resulted from natural circumstances. Schick (1985:793) demonstrated that Chimpanzees typically transport stones using a least-distance rule and transports of 500m are uncommon - possibly because of the difficulty of three-legged locomotion. There is no evidence that hominins transported multiple raw-materials/stone-tools except through hand-carrying. The importance of transporting tools/material through advanced planning is self-evident.

Stone-tools have numerous potential uses (d'Errico and Backwell 2009:1764-1765, Schick and Toth 2006:18, Semaw et al 2003:170). Isaac (2009:233) confirmed that a small sample of stone-tools had been used for cutting either wood or meat. Experimental studies suggest that potential uses include offense and defence (e.g. throwing and clubbing), butchery (cutting/skinning/marrow/brain extraction), excavating tubers/termites, tool-manufacture/refitting, and simple wood-working.

Debitage from refitting suggests that it was carried out on-the-spot (Hallos 2005:174) but so few examples have been found it questions the significance of refitting during the Oldowan. Isaac (2009:238) wrote that stone-tools were opportunistic and their common form indicates a 'socially learned knowledge' and therefore a 'simple level of culture'.

Osvath and Gärdenfors (2005:6) are confident that Oldowan hominins used stone-tools for woodworking. Although no archaeological evidence has been found we can agree, for example, that a wooden spear/club/throw-stick would be a significant aid in hunting.

Food

Parmularius [relative of Topi/Hartebeest] remains in Olduvai Bed I have skull depressions which may have resulted from being struck with stone-tools and other fauna herds had been driven into swamps (Leakey 1971:262).

Unfortunately hunting, unlike behaviours such as butchery and marrow-extraction, is invisible from the archaeological record and suggests cognitive abilities beyond those possessed by scavengers (Shipman 1986:28). Geist (Blumenschine 1987:396) believes that chimpanzees do not scavenge and hunting has been 'related to human adaptations'. Shipman (1986:37) believes that there are 'many biological and ecological differences between Oldowan and modern hunter-gatherers' and Stern (1993:201) adds that remains have 'only a superficial resemblance to those produced by living peoples.' I question over-reliance on actualistic-studies using extant primates and hunter-gatherers and disagree that hunter's cognition is necessarily more advanced than a scavenger or that scavenging was a marginal-existence; opportunity factors in an environment with large carnivores and migratory prey suggests that opportunistic-scavenging was the 'smart' option.

Olduvai animal remains contain cut-marks over-lapping carnivore teeth-marks which, if it is representative of Oldowan, indicated that hominins scavenged some food from carnivore kills (Shipman 1986:39). I suggest that hominins scavenging was an energy-efficient method of subsistence - Shipman (1986:32) observes that many extant scavengers are able to process rotten-food - and scavenging was potentially less variable and more energy-efficient than hunting.

Blumenschine (1987:383,387-8) studied the Serengeti and Ngorongoro Crater, which straddle Olduvai Gorge demonstrating that carcasses (abandoned prey and natural causes) are plentiful during the dry-season. Conversely the highest level of competition occurs during the rainy-seasons when migratory animals are absent.

Meat/Marrow was a significant part of hominin's calorie intake, perhaps as much as 50% of energy came from animal proteins - Speth (1989:33) indicates that fats provide 9-kcal of energy per/gram but carbohydrates only provide 4-kcal - but intake of herbaceous foods, such as fruit/berries, nuts and tubers, was an important part of an omnivore's diet (Osvath and Gärdenfors 2005:8). Some herbaceous foods may have been 'grazed' during a hominin's day but foraging suggests a division-of-labour.

Fire

Fire offers defence and warmth but also simplifies digestion of cooked-food. Some Oldowan sites, such as Koobi Fora and Chesowanja, suggest burning but there is no evidence of controlled use of fire (Barham and Mitchell 2008:140-141). Although it is possible that sparks, from flint percussion for example, may have resulted from tool-manufacture it can only be proven within Acheulean contexts (Schick and Toth 2006:23).

Family

Sexual dimorphism

Tomkins (1998:26-27) explains that hominin fossils demonstrate sexual dimorphism and Rose and Marshall (1996:316) say that the primary reproductive strategy of females was food-acquisition and male strategy was mate-acquisition. With an estimated annual mortality of up-to 15% (carnivores/natural-causes represent the greatest risk and infants suffered the highest mortality) effective selection was vital (Rose and Marshall 1996:313-315).

Childhood

Mothers expend significant energy and nutrients producing offspring with larger-brains/bodies (Tomkins 1998:82-83) - Barham and Mitchell (2008:151) estimate an additional 47-87%. Plummer (2004:128) feels that this would have been offset by having offspring less frequently. Increased brain-sizes and body-sizes produced helpless-young and later-adolescence; which necessitated a division-of-labour where social-groupings assisted mothers in feeding/weaning.

Social Groupings

Group structures - such as size, number of young and male/females - impacted a group's options (Leca 2007:692). For example 'males display more risk-taking behaviours than females' and the number of young impacts the distance a group could travel - and therefore obtain food.

Social-groupings offered hominins many advantages including shared learning, defence, outbreeding, food-sharing, varied diet, protection from predation, and rearing of young. Extended-childhoods, in my opinion, must necessitate a division-of-labour, social-groupings and suggest favoured-places - irrespective of whether hunter-gathering or opportunistic-scavenging was employed.

5. Conclusions

The Oldowan favoured-place as a micro-site - accepting that it may have been formed over longer periods of time and its full interpretation is speculative - allows us to establish connections between anatomical factors, ecological conditions, cultural factors and the development of cognitive traits leading to anticipatory cognition.

Ironically favoured-places can only offer us a narrow-view of the Oldowan and it is actualistic-studies which currently add most material to our 'knowledge'. I am optimistic that in the future archaeological studies will continue to play an increasingly active role in defining this formative period-of-time.

6. **Figures**

Figure-1.1: Taxa and Oldowan time-line
(after Schick and Toth 1993:79)

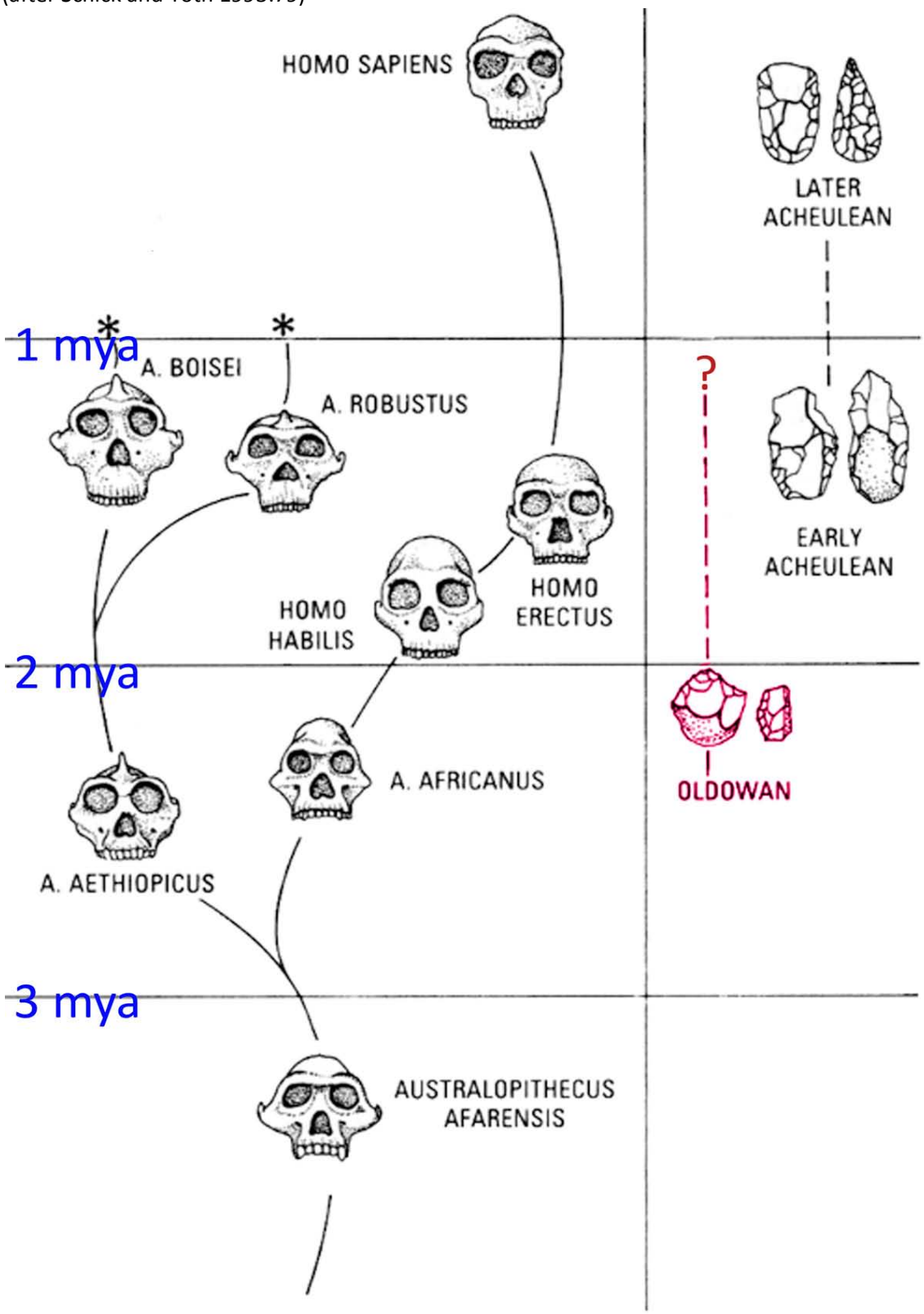


Figure-1.2: Oldowan Sites in Africa
(after Google Maps 2010, Schick and Toth 2006:10-18)

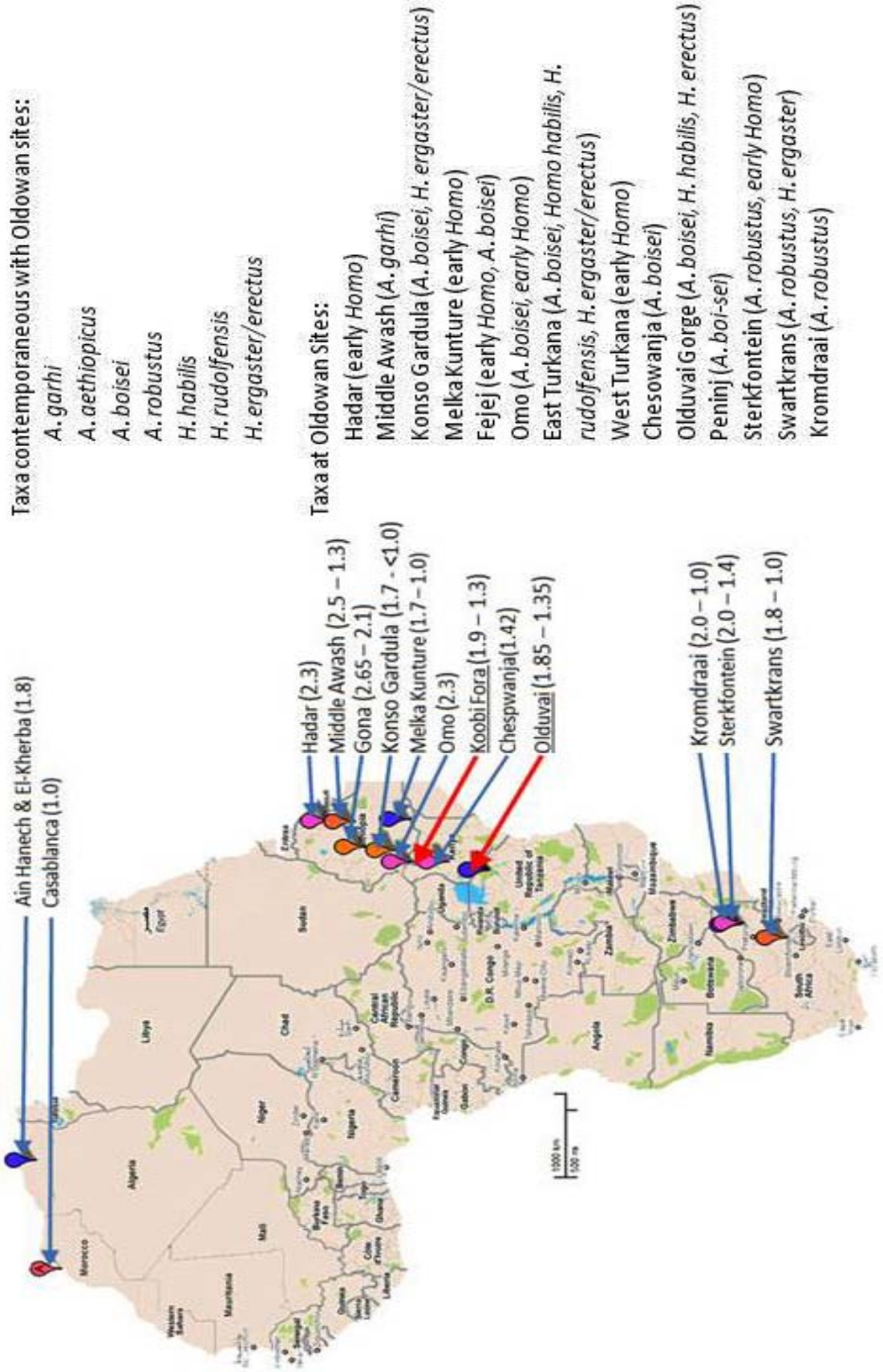
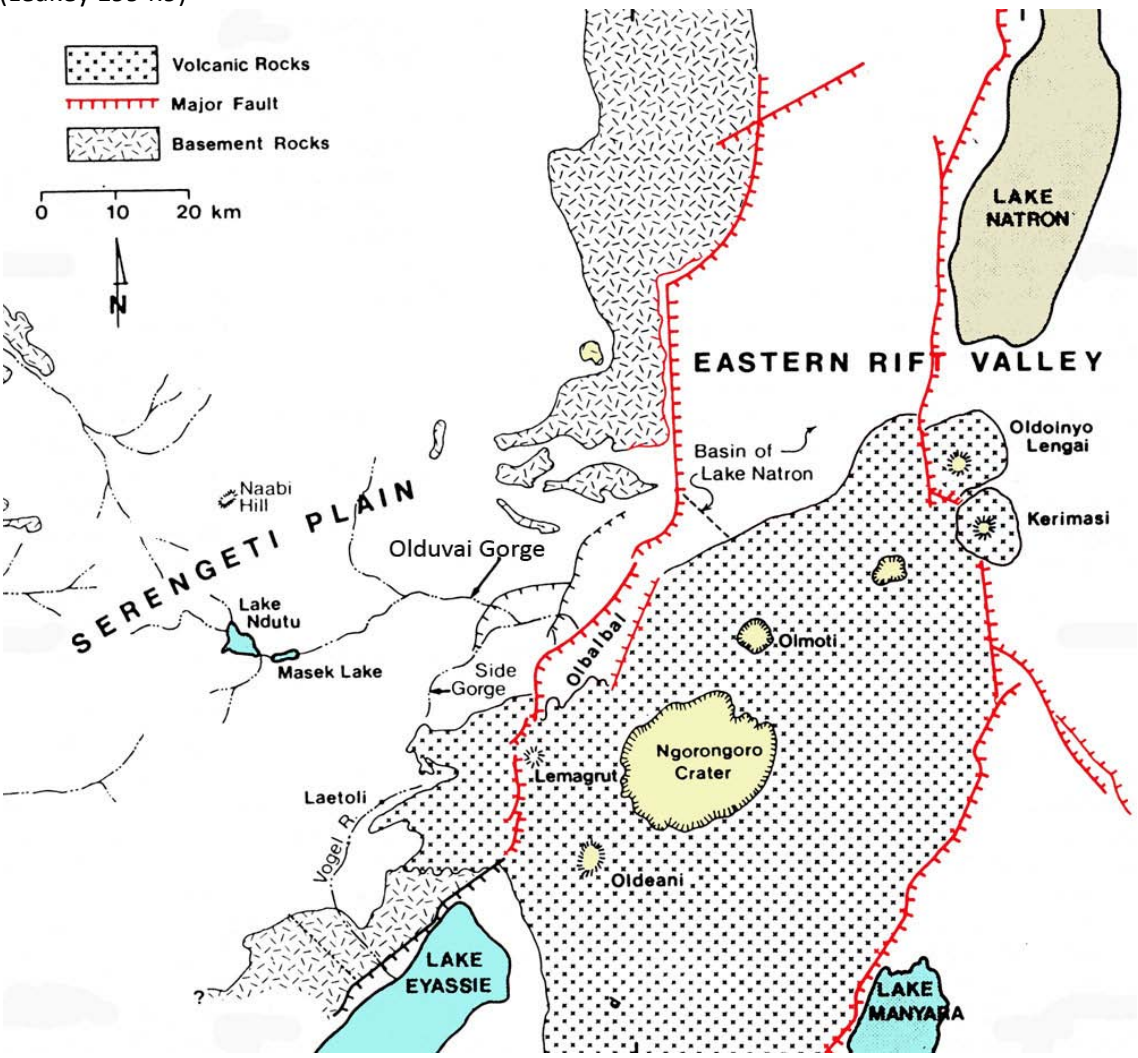


Figure-2.1: Geographic Location of Olduvai Gorge
(Leakey 1994:9)



Tectonic Plate and East African Rift (after USGS 2010)

Figure-2.2: Stratigraphy of Olduvai Gorge
(after Leakey 1967:96)

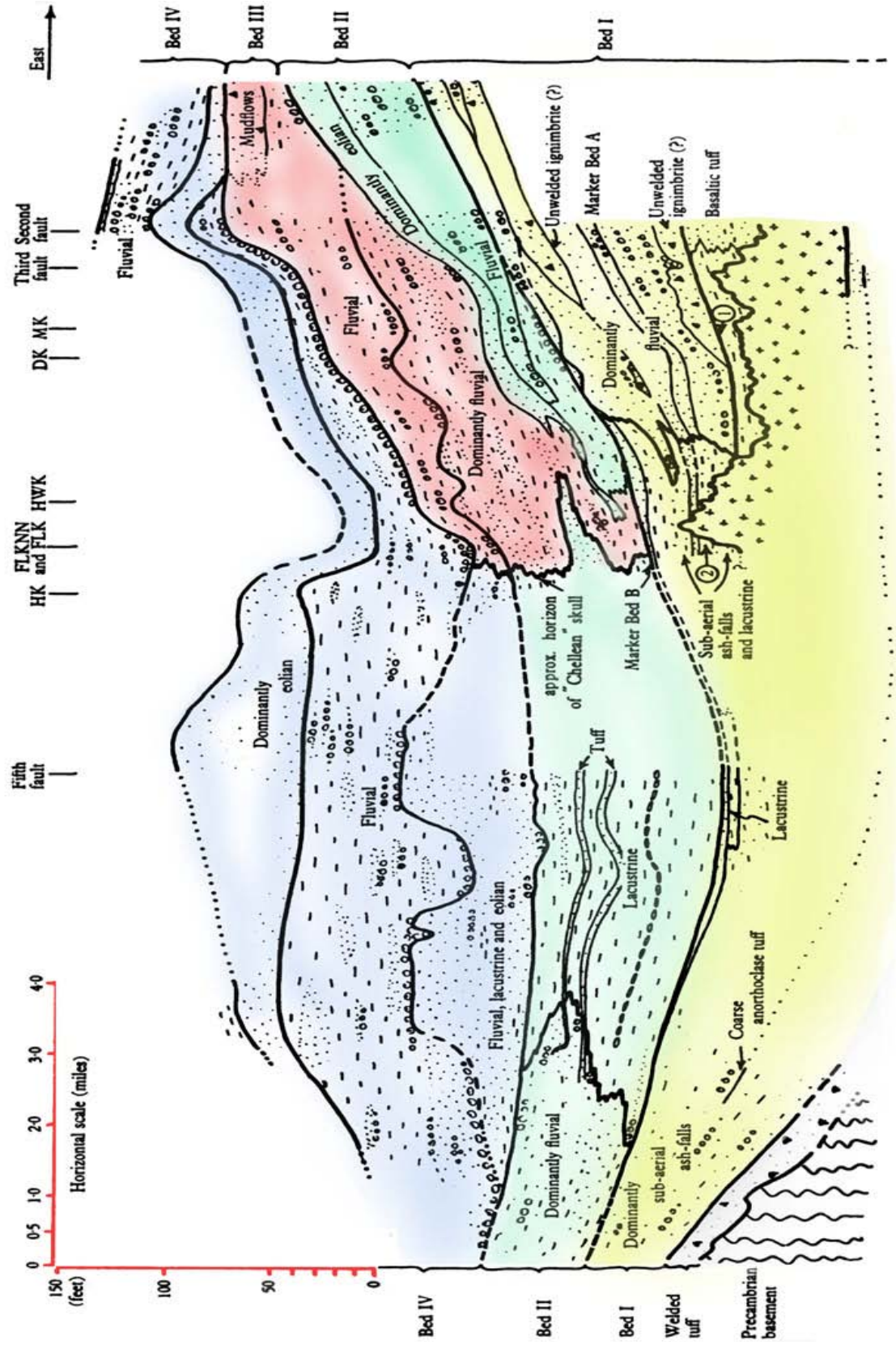


Figure-2.3: Geological impact on Sites
(Isaac 1979:111)

TOP: represents the original hominin activity and sites in the Rift Valley where, 2-mya, bones (red) and tools (black dots) were distributed across hills and floodplains.

BOTTOM: represents the current environment where remains from the floodplain are preserved within sediments (red layer), hills have been washed clear of remains and tectonic uplifting has altered the region's surfaces and stratigraphy.

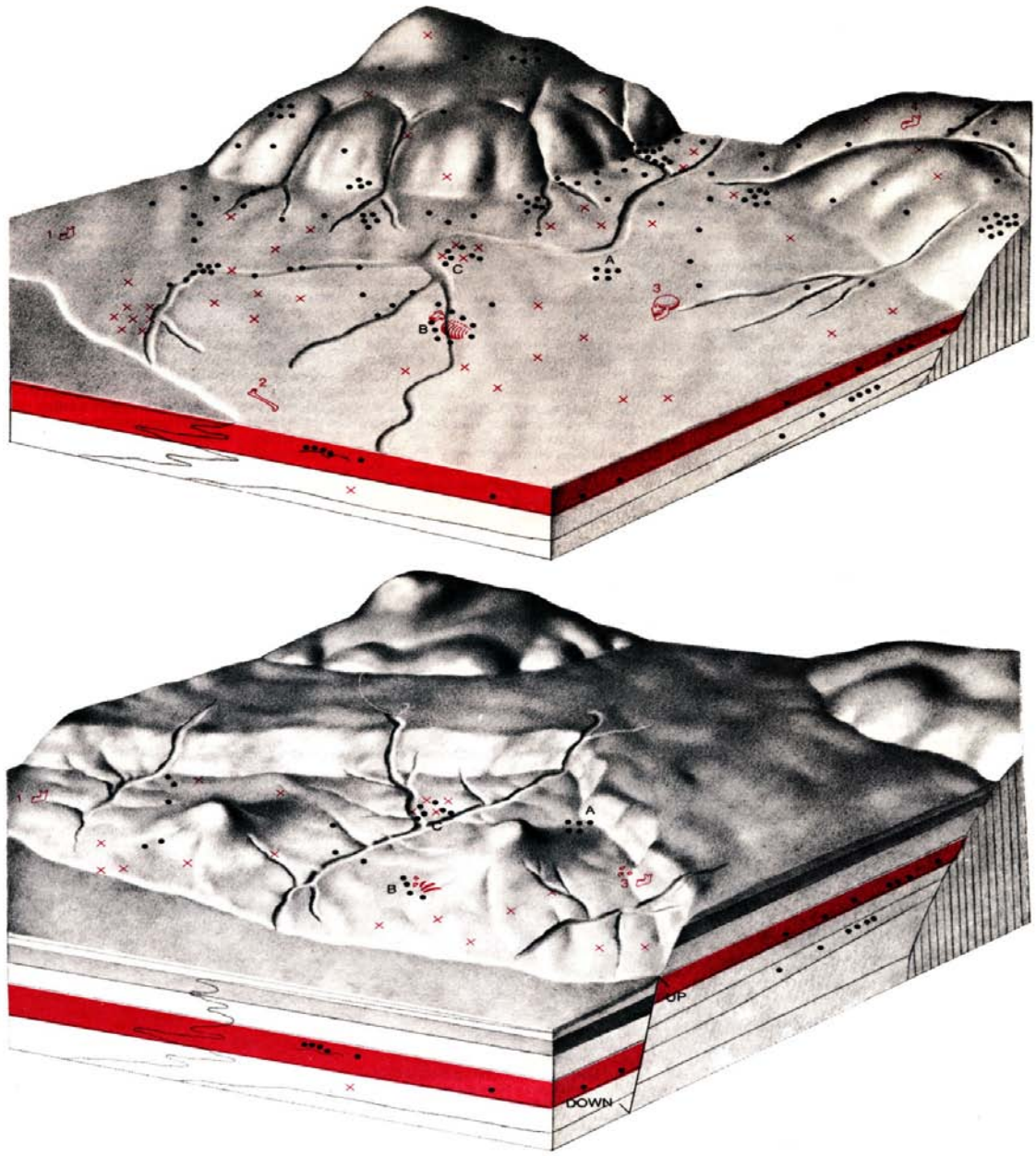


Figure-3: Glacial and Interglacial cycles
(after deMenocal 2004:17)

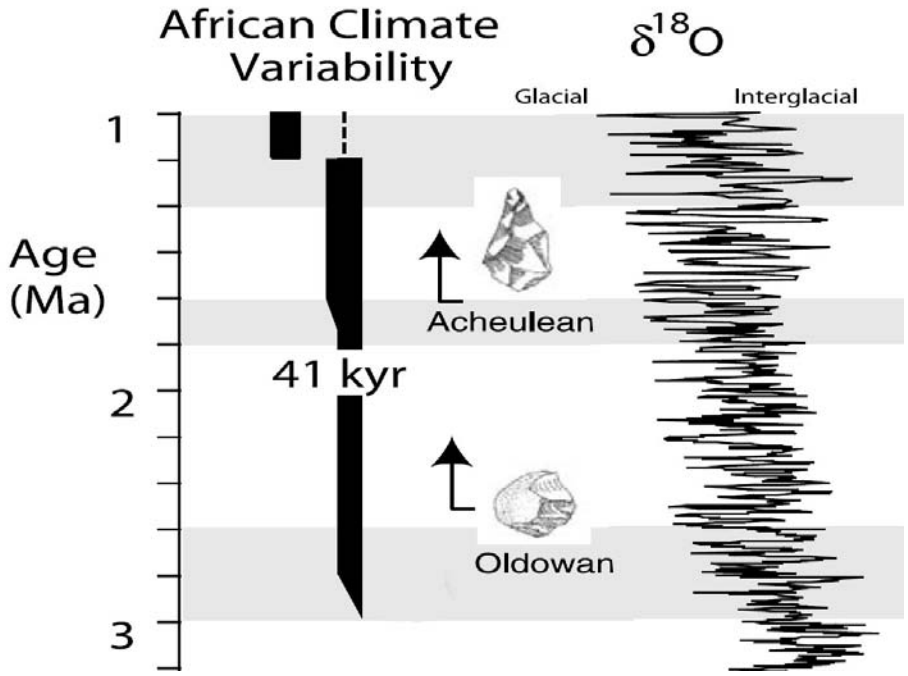


Figure-4: Faunal changes during the Oldowan
(deMenocal 2004:15)

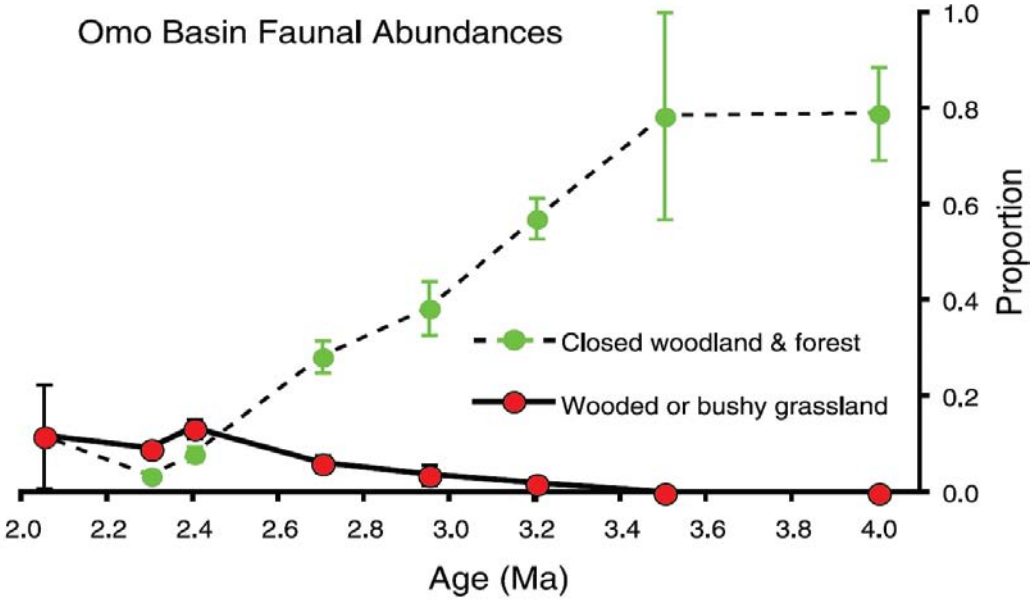
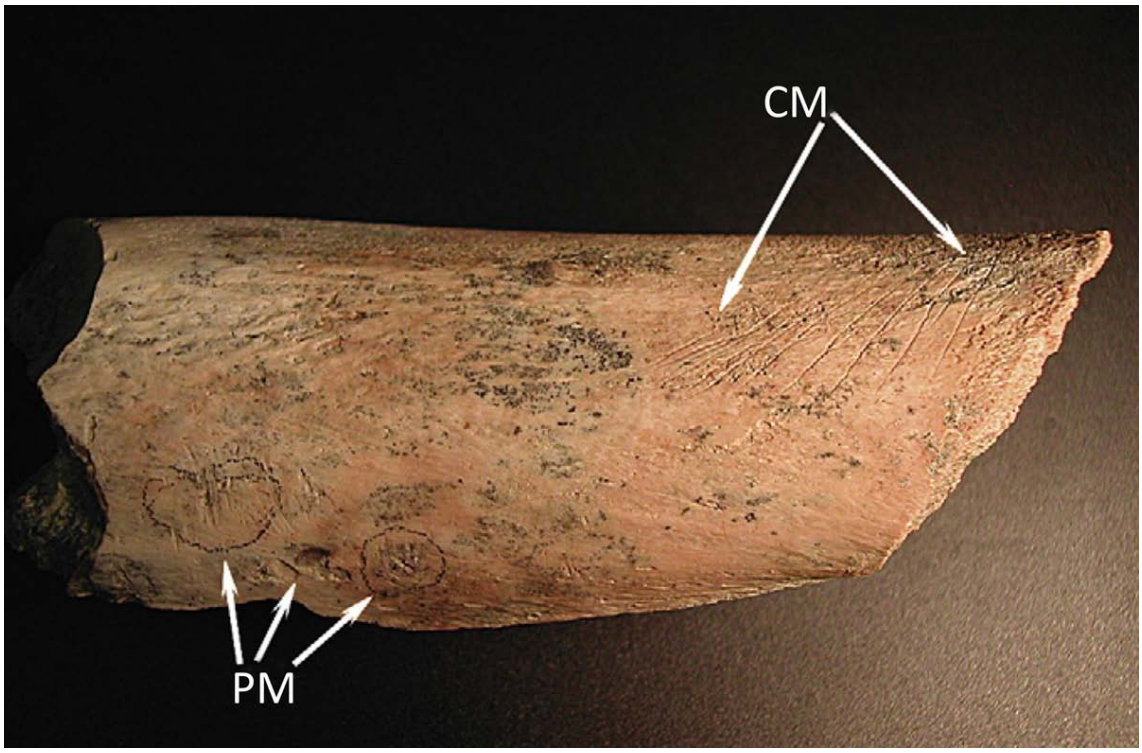


Figure-5: Mammalian bones from Bell's Korongo, Olduvai Gorge
Cut-Marks (CM) and Percussion-Marks (PM) (Domíinguez-Rodrigo et al 2009:277)



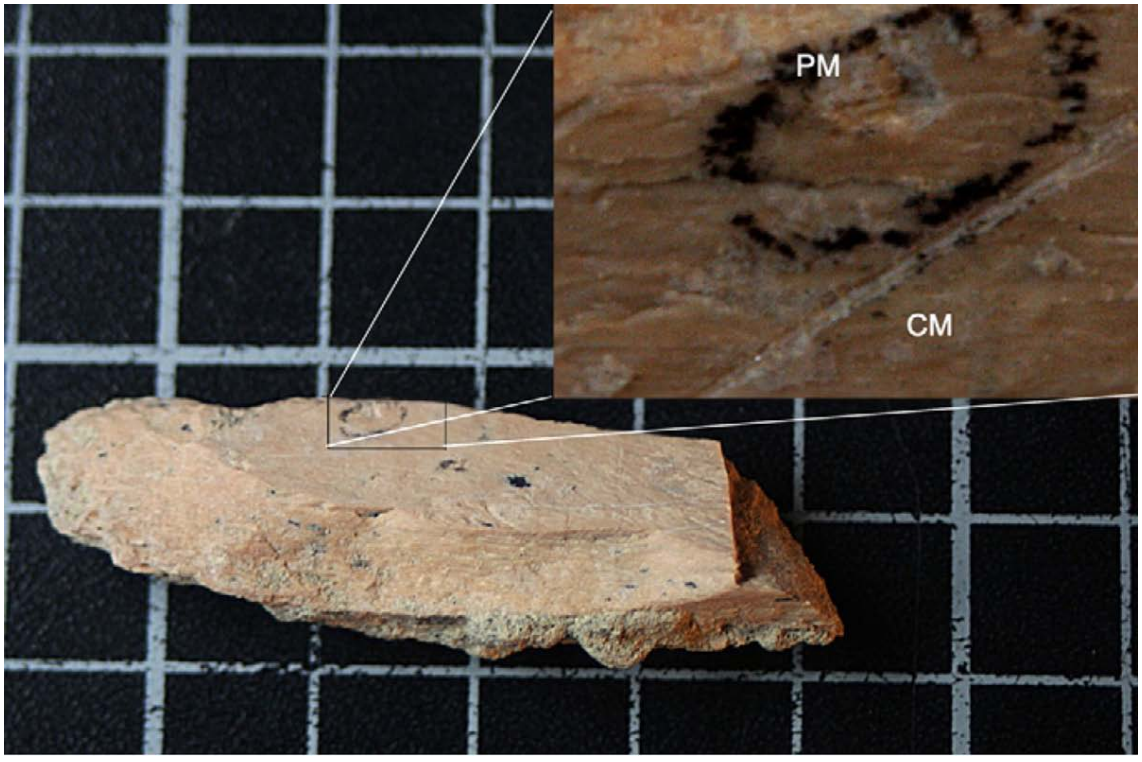


Figure-6: Footprints at Laetoli (30km south of Olduvai Gorge)
(Encyclopædia Britannica 2010)

Figure-7: Formation of favoured-place
(Isaac 1989b:334)

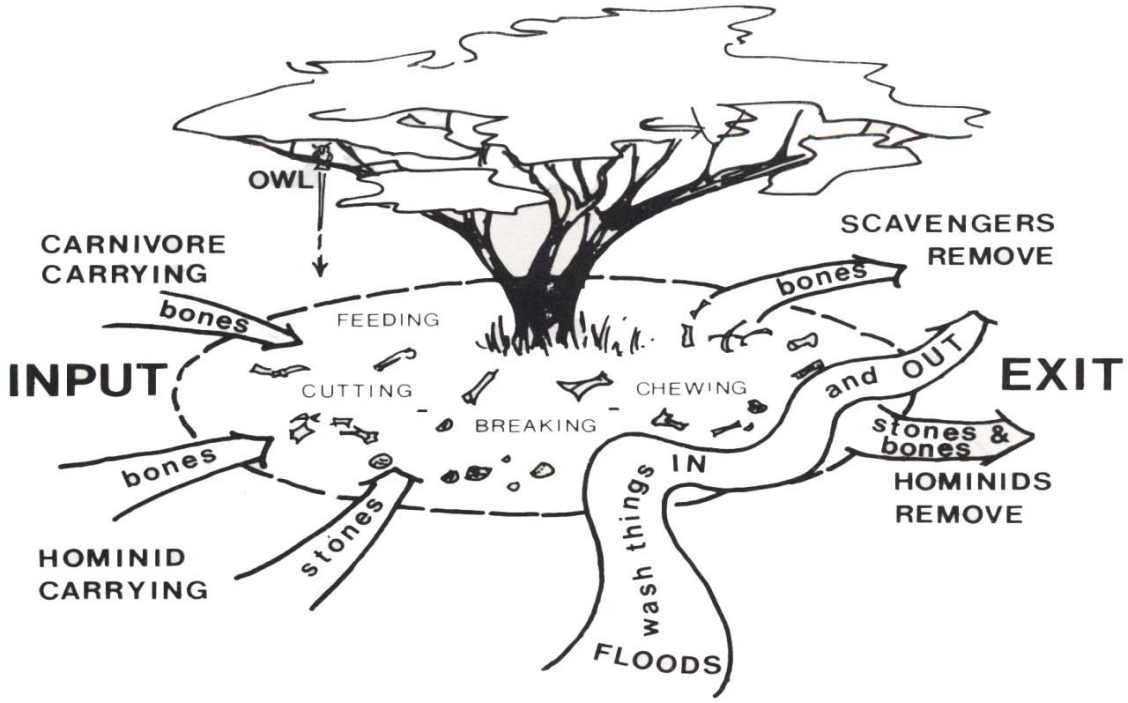
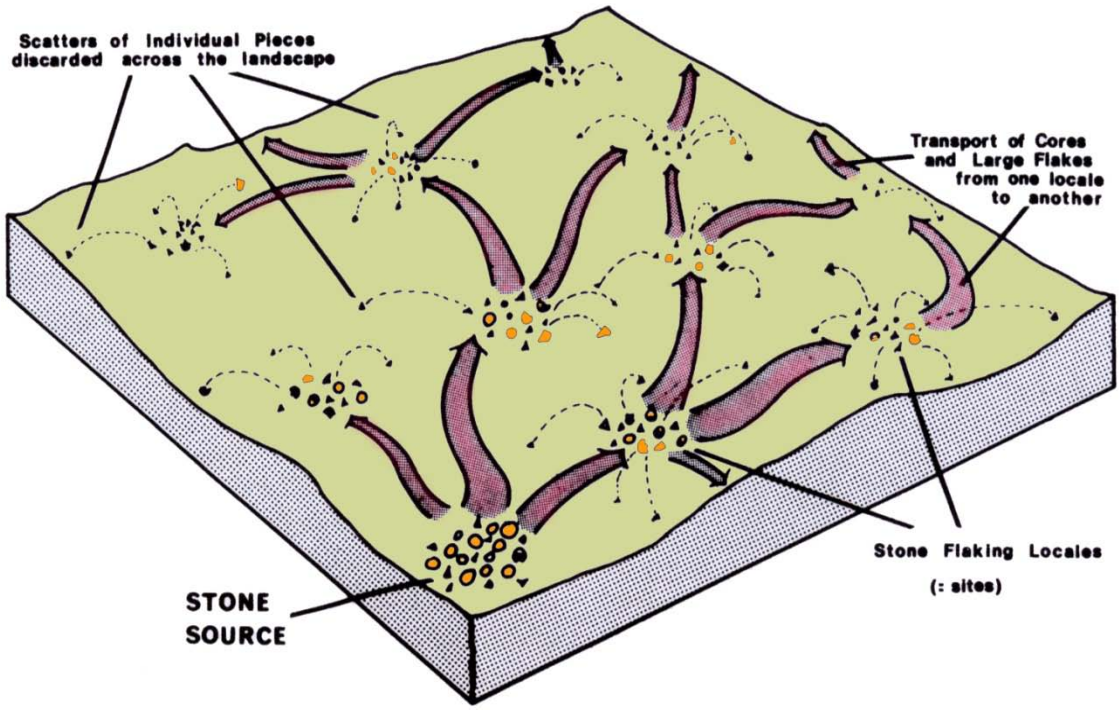


Figure-8: Transport and reuse of Stone Artefacts
(Isaac 2009:228)



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