Phillip G. Macumber
Richard C. Lakey
Ministry of Water Resources
Ruwi, Muscat
Sultanate of Oman

Phillip C. Edwards
Dept. of Archaeology
La Trobe University
Melbourne , Australia

M. John Head
Radiocarbon Dating Laboratory ,
A.N.U. Canberra,
Australia

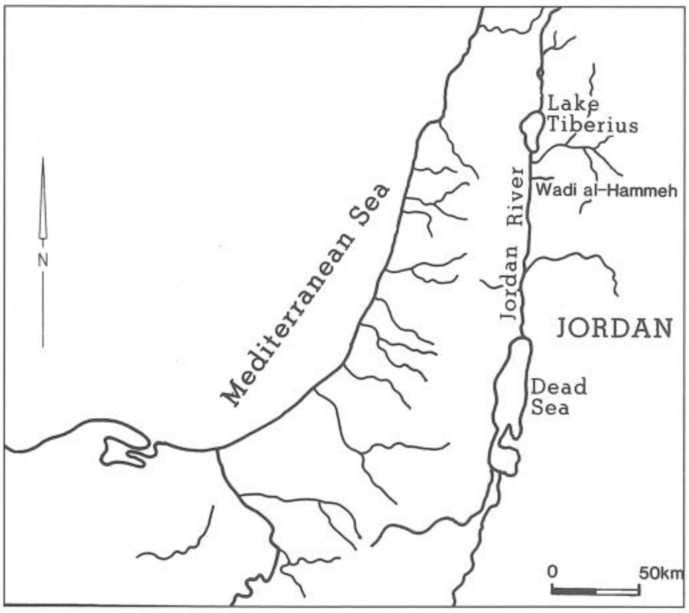
Phillip G. Macumber, Phillip C.Edwards, M. John Head and Richard C. Lakey

Physical Environment and Occupation in the Ṭabaqat Faḥl Region, Jordan over the Last Half Million Years

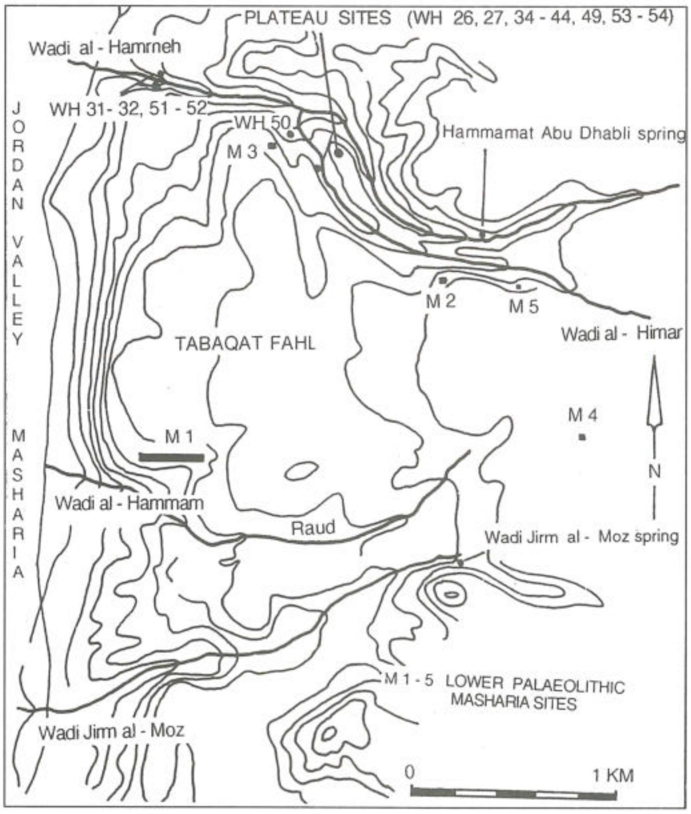
Introduction

The Ṭabaqat Faḥl region lies eastwards of the town of al-Mashāria' at the edge of the Jordan Rift Valley about 30 km south of the Sea of Galilee (FIG. 1). The region consists of a rectangular ten square kilometre buttress-like plateau (Ṭabaqah plateau - FIG. 2) rising steeply from the Rift Valley floor and lying at an elevation of approximately 125 m above the Jordan Valley (Macumber 1992). At the eastern margin of the plateau, the landsurface rises abruptly to the lower slopes of the 'Ajlūn Highlands. The Ṭabaqah plateau lies at an elevation of about ± 75 to ± 25 m, and appears to be the surface of an uplifted block – the Ṭabaqah Block – lying directly opposite the junction with the Jezreel Valley, itself part of the Rift Valley system.

The Ṭabaqah Block is bounded by deeply incised spring-fed wadis, the last phase of incision being in response to lowered base levels of erosion and sedimentation following the demise of Lake al-Lisān about 11,000 years ago (Macumber and Head 1991). These are the Wādī al-Ḥimma in the north and the Wādī Jirm al- Mawz the south; in addition there is the Wādī Khawaan in the centre. Very warm thermal springs feed Wādī al-Ḥimma, while the large springhead at Pella is situated at the head of Wādī al-Jirm (FIG. 3). The temperature of the Pella spring (s) is about 25° C which, while only marginally thermal, is still relatively warm, especially during the cold winter months. The spring outflow is about 1500 litre/second. Springs at Pella on Wādī al-Jirm and in Wādī al-Ḥimma, emerge at the far eastern edge of the block, suggesting groundwater flows up fracture zones associat-



1. Location plan of the Ṭabaqat Faḥl region. The Ṭabaqah Block lies immediately to the south of Wādī al-Ḥimma, about 30 km south of Lake Tiberias.



2. Ṭabaqat Faḥl region showing al-"Mashārīa'" and "Wādī al-Ḥimma" series archaeological sites. The contour interval is 20 m, and the lowermost contour is -200 m amsl with the Ṭabaqah Plateau lying between -80 and -20 m.

3. Pella springhead from Pella tall with Roman/Byzantine civic complex to left.

ed with Rift Valley faulting.

The Ṭabaqah Block has been a focus for major spring outflow fed by regional groundwater systems developed in Cretaceous and Lower Tertiary marine limestones aquifers since Middle Pleistocene times. Chert bands are common in the limestone, and chert boulders and pebbles, an important source of stone material, are an integral part of the fluvial conglomerates derived from these older sequences. Recharge of the aquifers occurs to the east on the higher regions of the Western Jordan Mountains.

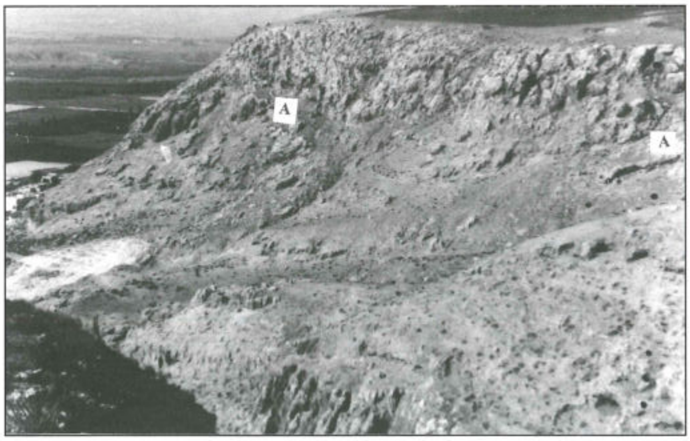
In situ archaeological sites span Lower, Middle, Upper and Epipalaeolithic periods and most of the Holocene. For instance, the Pella tall ranges in age from Chalcolithic up to Mamluke times, and the lower slopes are partially occupied by the village of Ṭabaqat Faḥl today (McNicoll, Smith *et al.* 1982; McNicoll, Hennessy *et al.* 1992)

Geology

The Pella tall deposits represent the most recent of three distinct cycles of sedimentation/occupation of the Ṭabaqah and its springs. The Ṭabaqat Faḥl Formation is the earliest sedimentary cycle forming the main part of the Ṭabaqah Block. The basal part of the Ṭabaqah Block is formed of fluvial chert and limestone conglomerate overlain by up to 100m of tufaceous limestone (Ṭabaqat Faḥl Formation), the latter deposited by groundwater which has since Middle Pleistocene times emerged in zones of regional outflow, along the edge of the Rift Valley. At the eastern edge of the block the conglomerates emerge from beneath the tufaceous limestone and rise onto the adjacent higher ground where they cap the hills. They outcrop on the Ramillah Ridge overlooking Wādī al-Ḥimma, where they contain Acheulian hand axes (Macumber1992). The tilt of the gravels and overlying limestone towards the Rift Valley is interrupted by a broad syncline visible in the southern side of the Wādī al-Ḥimār about 500m back from the rift edge and there followed by a tributary wadi.

The overall physical environment is that of a continental fluvial sequence (chert conglomerates) grading upwards into a groundwater-fed marshy plain (tufaceous limestone containing the freshwater snail *Melanopsis praemorsa*) bordering the Rift Valley. These sediments pass riftwards to merge with dense microcrystalline limestones, interpreted as lake or lake-margin deposits formed in an early pre al-Lisān Middle Pleistocene palaeolake. This lake was a precursor to Lake al-Lisān which occupied the Rift Valley from about 80,000-60,000 BP up to 11,000 BP (Neev and Emery 1967; Begin *et al.* 1974). On the Ṭabaqah Block, the earliest evidence of occupation appears in both the outcropping conglomerates and in the lowermost limestone sequences towards the base of the 125 m high Ṭabaqah plateau; it continues throughout the various sedimentary sequences up to the present. *In situ* sites containing Acheulian handaxes and bifaces occur within the limestone and perhaps in the conglomerate sequences (Macumber 1992). Although the Ṭabaqat Faḥl Formation is strongly tilted in places, the largest site – al-Mashāria'1 (FIG. 4) – lies within horizontally bedded and variously cemented tufaceous limestone on a very steep slope (at times vertical cliff face) some 30 to 40m beneath the surface of the plateau, and 90m above the Rift Valley floor. The zone of *in situ* occupation is over 400 m long and large numbers of artifacts are contained in both calcareous silt/stone and in hard, very dense limestone boulders eroding from the cliff face. The source of material for the artifacts is the chert pebbles and boulders in the underlying conglomerates.

The present elevation of al-Mashāria' 1 is believed to be due to post depositional uplift of the Ṭabaqah Block relative to the floor of the Rift Valley or perhaps lowering of the Rift Valley floor or a combination of both. As a consequence the Lower Palaeolithic al-Mashāria' 1 site which extends horizontally for 400 m back from the Rift Valley edge and contained within the Ṭabaqat Faḥl Formation, is now about 90m above the floor of the Jordan Valley to which it would have previously been graded. A similar case has been previously made to explain the present elevation of later sedimentary



4. Cliff face within the Ṭabaqat Faḥl Formation containing the al-Mashāria' 1 Acheulian site (A to A), 30 m from the top. Jordan Valley in the background.

sequences bordering the Rift Valley which contain Middle to Epipalaeolithic sites (Macumber and Head 1992). The implication is that during the Middle Pleistocene Period the region now represented by the Ṭabaqah, was a broad spring-fed fluvio-paludal embayment on the edge of an ancient lake. Subsequently there were phases of tectonism affecting the immediate region and eventually elevating the surface of the Ṭabaqah Block to its present height about 125 m above the Rift Valley.

During Middle Pleistocene times the Ṭabaqah Block and adjacent regions bordering the eastern Jordan Valley underwent a major phase of incision, perhaps in response to the phases of uplift which led to the formation of the Ṭabaqat plateau, and perhaps also to falls in base level following the drying of previously existing megalake systems. This event was followed by backfilling of the wadis in the Late Pleistocene in response to the gradual filling of Lake al-Lisān over the period from 60,000 BP (?80,000) up to 11,000 BP. In Wādī al-Ḥimma, a 60 m thick sequence of conglomerates, red and black clays and tufaceous limestone was deposited. This Wādī al-Ḥimma sequence (occurring beneath the plateau in FIG. 5) contains numerous bands of the freshwater snail *Melanopsis praemorsa,* which indicate fresh permanent stream flow. *The Melanopsis* bands are commonly associated with occupation sites.

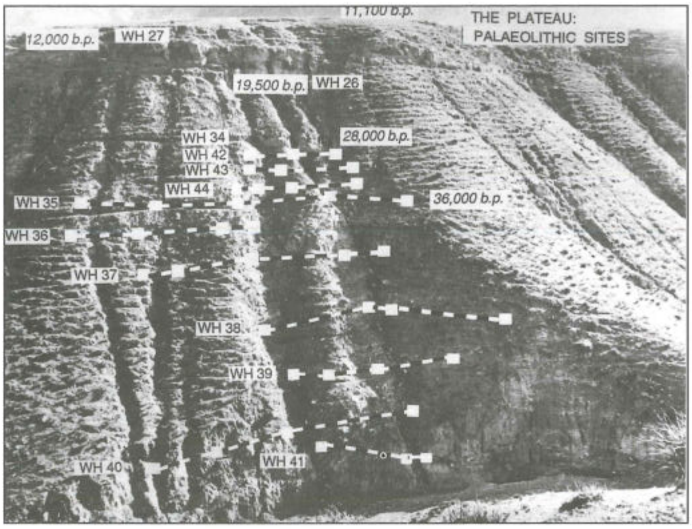
A downvalley diachronous lateral facies change in the valley fill from pebbles and red clays into buff coloured calcareous silts, travertines and conglomerates represents a change from a typical wadi environment (represented by pebble/red clay sequences) to a zone of regional groundwater outflow (carbonate cemented conglomerate and buff calcareous silts and travertine) developed in the lower wadi region adjacent to the lake. At about 1 km from the Rift Valley, the top of the sequence is at about - 80 m but is tilted at 7° to 8° westwards, to dip down towards the Rift Valley. The presence at the rift edge of low energy calcareous silts containing layers of *Melanopsis praemorsa* shells dated between 15,000 and 19,000 BP, at levels some 20m to 40m above the highest levels of -180m reached by Lake al- Lisān, is attributed to post-al-Lisān, tectonism (Macumber and Head 1991). *In situ* Kebaran sites (WH-51 at -156m, and WH-31 at -154m) and an Upper Palaeolithic site (WH-32) are contained within this sequence. A similar situation exists in nearby Wādī Khawaan, where spring tufas, Melanopsis bands and an *in situ* Natufian site (Wādī Khawaan 1) contained within well-bedded pisolitic gravels, overlain by a thick band of tufa (FIG.6) containing large roots and stalks - *Phragmites*?, are all found high in the landscape above the adjacent Rift Valley floor. A date from *Melanopsis* shells lying within and below a horizontal travertine/silt band on high ground close to the cliffed Rift edge at the nearby Wādī Khawwan 2 site gave an age of 11,620 +/- 240 BP (ANU-8470). While the conglomeratic and limestone sequences show folding and dip riftwards, the Ṭabaqah, as a whole, has maintained its overall integrity and appears to have moved essentially as a discrete block.

5. Tufaceous limestone at the Rift Valley edge which overlies the Wādī Khawaan 1 Natufian site.

As is the case with thick travertine deposits described from the northern Hula Valley (Heimann and Sass 1989), there is abundant plant material (*Phragmites?*) scattered in beds throughout the limestone sequences, however, faunal remains of a non-archaeological nature consist almost exclusively of *Melanopsis* shells. In the case of the Hula Valley occurrence, it was noted that the travertines were probably formed by slow moving broad shallow sheets of water. The near absence of travertine formation today in the Hula region is linked to post-depositional uplift resulting in changed (steepened) gradients which may have caused a reduction in water residence time and a concomitant cessation of travertine formation. Today, travertine is only actively being deposited around vegetation and on pebbles in the bed of the perennial Wādī al-Jirm, and it is possible that similar processes and environments to those in the northern Hula Valley were present in the regional groundwater discharge zones of the Ṭabaqat Faḥl region since Middle Pleistocene times.

Throughout this period occupation continued unabated, being largely concentrated in or close to the zone of freshwater outflow extending about 1km down to the palaeolake shoreline. *In situ* archeological sites occur throughout the 60 m of sediment, ranging from Middle Palaeolithic, through Upper Palaeolithic and Epipalaeolithic (Kebaran and Natufian) periods (FIGS. 6 and 7). They include the Wādī al-Ḥimma sequences and sites on nearby Wādī Khawaan. This phase of sedimentation and the Late Pleistocene occupation record ceased at about 11,000 BP when the wadis were again deeply incised up to 60 m in response to the demise of Lake al-Lisān and a fall in base levels of erosion and sedimentation. This in turn led to a concomitant drastic fall in water tables, with spring flow now emerging at the lower levels presently seen at the Pella tall and Wādī al-Ḥimma bath house, and along the edges of the Rift Valley. No earlier fall in water tables, or interruption to sedimentation or occupation, or wadi incision is recorded in the Wādī al-Ḥimma sequences during

6. View across Wādī al-Ḥimma towards the Jordan Valley. The al-Mashāria' 2 Acheulian site lies within the rocky area of the middle left background. The sediments beneath the (Wādī al-Ḥimma) Plateau in the middle ground contain the Wādī al-Ḥimma Middle, Upper and Epipalaeolithic sites (see FIG.7).



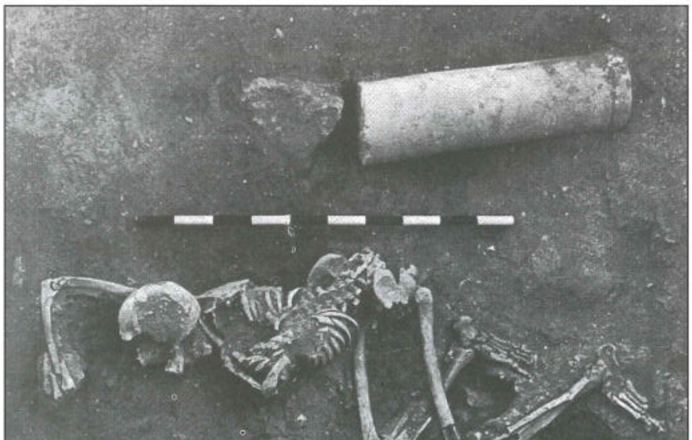
7. Wādī al-Ḥimma sequence showing excavated Palaeolithic sites and radiocarbon dates beneath the Plateau.

Late Pleistocene times over the period 18,000 up to 15,000 BP, despite the suggested very low Lake al-Lisān levels during the Late Glacial Maximum (Neev and Hall 1977).

Evidence for Late Pleistocene uplift of the Lower Palaeolithic sites in the Ṭabaqat Faḥl Formation (or depression of the valley floor) is supported by the high levels of dated sedimentary sequences containing Upper Palaeolithic and Kebaran sites in the lower regions of Wādī al-Ḥimma (Macumber and Head 1991) and a Natufian site in Wādī Khawaan (see below). These sites are situated well below ground surface, contained within horizontally bedded or slightly tilted carbonate sequences lying 30 m or more above the Rift Valley floor which, there, lies at much the same elevation as the uppermost levels of Lake al-Lisān (-180 m). It is to this level or perhaps even lower that the fluvial and spring-fed sedimentary sequences would have been graded. These sites now overlook the Rift Valley and the only explanation for their present position high above the Rift Valley floor, is neotectonics.

Support for ongoing Rift Valley activity is reflected in the numerous earthquake records of the region (for instance, Russell 1985; El-Isa and Mustafa 1986). Indeed, archaeological evidence indicates that the Pella tall which has a 7000 year old history has been repeatedly affected by earthquakes caused by movements along the Rift Valley faults. Examples of suggested earthquake impacts from Pella include the destruction of the Umayyad town in 747 AD (FIGS. 8 and 9) and the Abbasid Western Complex in 853/4 AD (Wamsley, in Walmsley *et al.* 1993), the (Byzantine) Church (McNicoll, in McNicoll *et al.* 1986) and the Byzantine Fortress in

8. Partially reconstructed Umayyad town of Pella destroyed in the 747 earthquake.



9. Human earthquake victim killed in 747 earthquake at Pella (North Building room no. 16, Area IV).

659/660 AD (Watson, in Walmsley *et al.* 1993)

Occupation

Clearly the single most important factor in the semi-continuous occupation of the Ṭabaqat Faḥl region throughout Middle to Late Quaternary times, was the presence of broad zones (spring-fed plains) of regional/local groundwater outflow emerging marginally to large lakes. The broad regional outflow zones of the Pleistocene Period were reduced to single springhead complexes in Holocene times (see FIG. 3), following the demise of the earlier megalakes, the concomitant fall in groundwater outflow and water tables, and the deep incision to give the present day landscape. The importance of the groundwater outflow zone to continuing occupation cannot be overstated. The springs are conduits for the naturally regulated release of regional groundwater systems that have been fed from a large recharge catchment refilled over millennia and extending over thousands of square kilometres, perhaps as far eastwards as the al-Azraq Basin. Flow times for water infiltrating within the highland catchments and discharging into the Rift are put at about 3,500 years (Salameh and Udluft 1985). Radiocarbon dates from *Melanopsis* shells at the present Pella spring-head give ages of about ca. 4,000 years, supporting these conclusions. Unlike the rivers and streams, the springs and their associated discharge zones are strongly buffered against seasonality and short term to long term periods of aridity that are known to have affected the region since Early Pleistocene times.

An indication of localized environment amelioration in the past is seen in the presence at the Kebaran site - WH 26 (see FIG. 7), radiocarbon dated at 19,500 +/- 600 BP of a localized remnant Mediterranean woodland association including trees and shrubs such as oak, almond, pistachio, buckthorn, hawthorn, and hackberry (Edwards *et al.* 1988). Notably, none of these species grow in the wadi today, and the Mediterranean zone does not appear until c. + 100m above sea level, some 200m higher than the altitude of the Kebaran sites. The faunal evidence at the site includes gazelle, sheep/goat, wild pig, fox, hare, wild cat, quail, song bird, tortoise and freshwater snail.

A similar, albeit larger, faunal assemblage occurs in the overlying Natufian WH 27 site (see FIG. 7) dated at ca.12,000 BP . The Kebaran to Natufian periods span the Late Glacial Maximum when there is a general recognition that conditions were significantly more arid and cooler than at present. No evidence for these harsher conditions exists in the geological or hydrological evidence from Wādī al-Ḥimma, despite the excellent geological, archaeological and chronological record. The low altitude of the Jordan Rift Valley provided as amenable a temperature regime as could be expected in the Levant during the Late Glacial Maximum, and it is not surprising that occupation continued in Wādī al-Ḥimma throughout that period. A combination of factors, such as reliable fresh warmish spring waters, a large supply of chert material for artifacts, the availability of game and plant resources, and moderate temperatures no doubt explains the attraction for human occupation at the time.

During early Holocene times, following incision, the significantly reduced (although still considerable) outflow represented by the Pella spring became established roughly in its present position at the top of Wādī Jirm al- Mawz. Occupation of the Pella site from Chalcolithic times through Bronze Age, Iron Age, Hellenistic, Roman, Byzantine, Mediaeval Islamic and Mamluk times indicates the importance of the stable Pella spring environment over this period. The present day situation within the Wādī Jirm al-Mawz of outflowing uncontaminated fresh springwater feeding pools containing *Melanopsis praemorsa* shells, visited by large numbers of people (especially on holidays), echoes an especially favourable physical environment that has existed in the Ṭabaqat Faḥl region for perhaps half a million years. In this sense the area has remained, since Middle Pleistocene times, an especially valuable piece of Rift Valley real estate, which provides a predictable, secure and well watered micro-environment, despite, and essentially immune to, the climatic vagaries existing regionally outside the valley.

Clearly, the spring systems of the Ṭabaqat Block provide an environment of stability and predictability, in which occupation has flourished over a very long period of time. However, the springs are linked to an active Rift Valley fault system, which has seen the accumulation of 10 km of sediment in the Rift Valley over a relatively short time period, perhaps since late Miocene times (Ginzberg and Kashai 1981). This gradual Rift Valley evolution has been witnessed by man who is known to have been in the region for at least 1.4 million years as shown by the 'Ubeidiya Early Pleistocene hominid site (Tchernov 1987), where the fluvial and lacustrine sequences containing human remains are overturned and steeply dipping.

It follows that there has been a duality of existence in this region, with long periods of stability and prosperity abruptly ending in catastrophic destruction as faulting is reactivated. In Pella, the periodicity of archaeologically ascribed earthquake destruction is in the order of a few hundred years at the most. Whether this periodicity is valid, and there is no reason to doubt certain of the events, it does underline an important feature affecting long term existence (and survival) of Rift Valley settlements, and is probably one of the most likely explanations for otherwise unexplained periods of abandonment, as was the case for Pella in the 17th and 18th centuries.

Perhaps the best documented case of this duality of existence comes from Genesis 13-19 set in the Rift Valley at the southern end of the Dead Sea, where Lot left Abraham to go down into the Jordan Valley where there was much water - *"like the Garden of the Lord or the Land of Egypt"*, but the cities of the valley and all the citizens were destroyed by brimstone and fire, in an episode for which, whatever the absolute cause, the mechanism was almost certainly an earthquake.

Conclusion

The Ṭabaqat Faḥl region contains one of the longest documented records of semi-continuous occupation anywhere in the Middle East, going back at least 300,000 years. Over this time, plentiful supplies of fresh water from springs emerging along the edge of the Rift Valley provide a micro-climate conducive to stability and prosperity. Ironically, this cosy environment was periodically interrupted catastrophically by phases of tectonism, generated by the Rift Valley faults system, the same system directly and indirectly responsible for the groundwater outflow which enabled the favourable environment necessary for long term occupation.

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