ABSTRACT Wezmeh Cave is located on the northeastern edge of the Islamabad plain, a high intermontane valley in the western-central Zagros. In 1999 a disturbed but large faunal assemblage was recovered from this site. The abundant and extremely diverse faunal spectra present at Wezmeh Cave has highlighted the importance of this assemblage. Carnivore remains constitute the bulk of the assemblage; red fox (Vulpes vulpes) has the highest number of identified specimens followed by spotted hyena (Crocuta crocuta), brown bear (Ursus arctos), wolf (Canis lupus), felids (lion, leopard, lynx/caracal and wildcat), mustelids (badger, polecat, marten) and viverrids (mongoose). Artiodactyls (bovid, cervid, suid), equids, rhinoceros (Dicerorhinus sp.) and small animals (Cape hare, porcupine, tortoise, snake, birds) are also present. According to U-series dating, the site was occupied from around 70 ka BP through to sub-recent periods by carnivores. Amongst this rich assemblage, a human fossil tooth was also found and dated by non-invasive spectrometry gamma dating to 20–25 ka BP. A preliminary zooarchaeological and taphonomic study shows that Wezmeh Cave was used by multiple carnivore species, a unique phenomenon in the Zagros Mountains in particular and southwest Asia in general. Copyright © 2008 John Wiley & Sons, Ltd.

Key words: spotted hyena; brown bear; carnivores; human; U-series dating; Late Pleistocene; Zagros; Iran
**Introduction**

The Wezmeh Cave faunal remains provide an exceptional assemblage in southwest Asia, both in terms of its size and diversity. However, the cave was looted, which disturbed the stratigraphy even though the faunal remains were not removed or destroyed, as attested to by their excellent state of preservation. Following the recovery of faunal materials in 1999 and again in 2001, a palaeontological study of them, as well as the dating of several bones, has emphasised the importance of this cave and its assemblage. These efforts are also aimed at promoting the conservation and preservation of such sites by the Iranian authorities, since Wezmeh is among the rare cases where Pleistocene human presence has been proven.

**The state of Pleistocene faunal research in the Zagros**

The Late Pleistocene fauna of the Zagros region is largely known through assemblages excavated in several caves and rockshelters with remains of Middle, Upper and Epi-Paleolithic occupations. Most of the excavated sites are located in the high intermontane valleys of Kermanshah and Khoramabad (Figure 1) and in the western foothills of the Zagros in Iraqi Kurdistan (Braidwood, 1960; Braidwood & Howe, 1960; Solecki, 1963; Smith, 1986). There are also a few excavated assemblages in the Fars region (Rosenberg, 1985). Among faunal assemblages from this region that have been published in detail are the Middle Paleolithic sites of Warwasi, Kobeh, Bisitun and Mar Tarik in the Kermanshah region (Coon, 1951; Turnbull, 1975; Marean & Kim, 1998; Jaubert et al., 2006), Humian near Kuhdasht, Tamta near Lake Urmia, and Shanidar in the western foothills of the Zagros (Coon, 1951; Perkins, 1964; Bewley, 1984). This is also the case for Upper Paleolithic and Epipaleolithic assemblages from Warwasi and Ghar-e Khar in the Kermanshah region, Yafteh near Khoramabad, and Palegawra and Zarzi in Iraqi Kurdistan (Garrod, 1930; Turnbull & Reed, 1974; Turnbull, 1975; Hesse, 1989; Otte et al., 2007). Other excavated faunal assemblages that are published only in brief notes or as inventories are Eshkaf Gavi (Fars), Kunji (Khoramabad), and Koulian (Kermanshah) (Hole & Flannery, 1967; Rosenberg, 1985; Biglari & Taheri, 2000). In most cases, these Paleolithic and Epipaleolithic assemblages are dominated by caprines, as at Shanidar, Kobeh, Ghar-e Khar and Yafteh. There are a few exceptions, such as Warwasi which yielded a large number of equids, or Bisitun Cave with a high percentage of equids and red deer. A common pattern in these assemblages is the dearth of carnivores. Such herbivore-dominated assemblages are unlikely to be representative of Late Pleistocene fauna of the region generally.

The discovery of the rich Late Pleistocene faunal assemblage from Wezmeh Cave in the Kermanshah region of western-central Zagros has for the first time allowed us to examine an assemblage that shows a high diversity of the region’s fauna, a faunal diversity which is greater than would be expected solely from human-processed carcasses. Wezmeh Cave is also important with respect to Late Pleistocene human remains. Since the discovery of a Middle Paleolithic hominin specimen at Bisitun cave in the late 1940s and a large number of Neanderthal remains at Shanidar in the 1950s and 1960s (Trinkaus, 1983; Trinkaus & Biglari, 2006; Coggill et al., 2007), this is the first new Paleolithic human fossil site in the Zagros.

**The site**

Wezmeh Cave is located at N34°03‘20” and E46°38‘42”, about 12 km southeast of the town of Islamabad-e Gharb and 3.5 km northeast of the village of Tajar-e Akbar. The cave is at an elevation of 1430 m asl, approximately 100 m lower than the summit of the Qazivand Mountains, about 60 m above the valley floor on a 36° slope. Wezmeh Cave is almost horizontal, formed between geological layers of karstic limestone. The mouth of the cave faces north and is 2 m wide and 1.2 m high. The cave is about 27 m long and has about 45 m² of floor area (Figure 2). For about 12 m in from the entrance, the cave is relatively straight. At about 15 m from its mouth, the cave makes a sharp turn towards
the west and extends for about 5 m, in which the height of the ceiling gradually increases. The floor of this section also has a 13° downwards slope which leads to a large pit (ca. 4 × 2 m) excavated by clandestine diggers. This section of the cave extends for 5 m and then makes a turn towards the southwest and extends for another 7 m with a steep downwards slope (Abdi et al., 2002).

The cave is not located in an active karst zone, but rather in a relatively arid area. However, one can see a layer of calcium carbonate deposited as flowstone, particularly towards the rear of the cave. Prior to clandestine excavations in the cave,
the rear section was filled with sediments, in places up to 4 or 5 metres deep. These deposits, which represent thousands of years of sedimentation, can be attributed to a combination of the following processes: (1) sediments carried by water through cracks and cavities in the cave’s walls and ceiling (on the plateau above the cave there is an open area amenable to erosion during the rainy season); (2) weathering and pedogenesis during climatic oscillations; (3) decomposition of floral and faunal material; and (4) wind-blown silt and sand.

In terms of texture, colour and morphological characteristics, the debris left by clandestine diggers is similar to sediments encountered in test excavations (see below). A depositional layer

Figure 2. Wezmeh Cave. Map of the cave with the original location of the bone assemblage (after Abdi et al., 2002).
similar to the main sediments at Wezmeh Cave can be seen in the general Kermanshah-Mahidasht area, including Fan 5 in Mahidasht, tentatively dated to the later Pleistocene between 35–14 ka BP, which shows a calcified deposit, that is, a mixture of sediments with calcium carbonate (Brookes, 1989). Geomorphological studies of the Kenesht and Sorkheh Lizheh fans in the Kermanshah area, tentatively dated to 24–13 ka BP, also indicate similarities with deposits from Wezmeh Cave. Therefore, it seems reasonable to assume that the Wezmeh Cave deposits roughly correspond to the calcified sediments of Fan 5 and Units B-E and 3 at the Kenesht and Sorkheh Lizheh fans on the Mahidasht (Heydari, 2000).

Excavations

The initial survey of Wezmeh Cave (Abdi et al., 2002) indicated that the deposits had been partially emptied and scattered on the talus slope by looters, leaving a mix of Chalcolithic archaeological remains and Pleistocene fauna on the surface. The test pits in the cave indicated that there had been a thin, ashy layer of Chalcolithic remains overlying a sterile level, which overlay the deeper Pleistocene deposits with the faunal remains. All of the archaeological remains (ceramics and a small number of lithics) and a portion of the osteological remains were referable to the Chalcolithic. A large portion of the osteological remains appeared to be Pleistocene in age, given a distinctly different preservation and patina. The bones were therefore sorted on the basis of these preservational characteristics into Pleistocene and Holocene samples; any errors using these criteria are likely to have only minor effects on the distributions presented. It is these Pleistocene remains on which this analysis is based.

Once observations of the faunal material from the initial 1999 survey underlined the cave’s significance, some of the authors returned to the site on 12–15 August 2001 to salvage as much material as possible. We began our work by carefully probing the debris left by clandestine diggers and collecting larger bones and archaeological material. We also screened areas on the slope, especially those with small bone concentrations. Probing and screening the debris in this fashion produced over 20 kg of bones.

We continued our probe of the debris all the way up to the relatively flat area in front of the cave mouth, where we opened an exploratory 3 × 3 m trench. Inside the cave, we put in six test pits at 2 m intervals. All of them show a similar stratigraphy, consisting of an overlying layer of debris left by clandestine diggers and an underlying sandy deposit with varying amounts of material. The depth to which each test pit reached depended on the slope and angle of the cave walls. These excavations produced more bones and a handful of small archeological finds, mostly ceramics (Abdi et al., 2002).

The faunal assemblage

The palaeontological study is mainly based on the well-preserved, identifiable and most representative vertebrate material. The study took place partly in Iran at the National Museum of Iran, but mainly at the Muséum national d’Histoire naturelle in Paris, where this material is presently stored but will be returned to Iran. The faunal species were divided into predators and prey and are described by ‘numbers of identified (to taxon) specimens’ (NISP counts) and estimated ‘minimum number of individuals’ (MNI). The latter was calculated as the minimum number of individual animals necessary to account for all the kinds of skeletal elements found in the skeleton of a taxon, taking age and size into account.

The predators: the carnivores

All of the carnivore families previously mentioned as present during the Late Pleistocene in the Middle East (Kurtén, 1965; Harrison, 1968; Dayan, 1994) are present in the Wezmeh assemblage (Table 1; Figure 3): Hyenidae (spotted hyena), Ursidae (brown bear), Canidae (wolf and red fox), Felidae (lion, leopard, lynx/caracal and wild cat), Mustelidae (badger, stone marten and polecat) and Viverridae (mongoose).
The spotted hyena (Crocuta crocuta)

During the Pleistocene, the Hyaenidae are well represented in southwestern Asia. The great majority of the specimens belong to the spotted hyena, which is now extinct in the area, whereas only a few fossils are referable to the striped hyena (Hyaena hyaena), the only extant species there.

The hyena found in Wezmeh Cave has the morphology of the spotted hyena (Crocuta crocuta). This material corresponds to a minimum of ten individuals, mainly young adults, and is represented by all the skeletal parts with 33.9% cranial elements and 66.1% postcranial elements (Monchot, in press).

The spotted hyena, the most common large carnivore during the Pleistocene in southwest Asia, is known since the Early Pleistocene in ‘Ubeidiya (Ballesio, 1986; Belmaker, 2006) and later on is present in the main Middle–Late Pleistocene sites from the southern Levant, in the Mount Carmel such as El-Wad C-E, Skhul, Tabun B-C (Bate, 1937; Garrard, 1980, 1982), Geula (Monchot, 2006), Sefunim (Tchernov, 1984), Kebara MP (Middle Paleolithic) and UP (Upper Paleolithic) (Dayan, 1994), and in adjacent parts of northern Israel at Hayonim (Rabinovich, 2002), Qafzeh MP-UP (Rabinovich et al., 2004) and Zuttiyeh (Bate, 1927). C. crocuta was mentioned also in the Jordan valley in Oumm...
Figure 3. 1–2. *Crocuta crocuta*. 1: Mandible fragment with the lower carnassial M1 (WZ 1 dex.); a, lingual; b, labial. 2: Maxillary fragment with the upper carnassial M1 (WZ 1525 dex.); a, lingual; b, labial. 3–4. *Ursus arctos*. 3: Upper M2 (WZ 100 dex.); a, occlusal; b, lingual. 4: Lower M1 (WZ 1595 sin.); a, occlusal; b, labial. 5–6. *Panthera leo*. 5: Humerus distal (WZ 349 sin.); a, anterior; b, lateral. 6: Lower canine (WZ 486 dex.), lateral (drawing M. Ballinger).
Qatafa (Vaufrey, 1951) and in Lebanon at Ksar 'Akil (Hooijer, 1961; Kurten, 1965), Adlun (Garrard, 1983), and Ras-el-Kelb (Garrard, 1998).

The spotted hyena underwent a significant decrease in numbers during the last glacial and disappeared from southwestern Asia (including the Iranian Plateau) at around 13–11 ka BP (Stuart, 1991; Stiner, 2004). The Wezmeh mandibular tooth measurements (Figure 4) are comparable in size to Levantine Mousterian spotted hyena, and support the allocation of this portion of the Wezmeh assemblage to the earlier Late Pleistocene (stage 5).

The striped hyena (*Hyaena hyaena*) is present in some Paleolithic sites and currently occurs on the Iranian Plateau (Kaftarkhoun: Mashkour, 2004). Often in the Zagros, as in Warwasi (Turnbull, 1975) or Kobeh cave (Marean & Kim, 1998), the hyena remains are too scanty to allow a reliable generic attribution between the two hyena species. Interestingly, in some southwest Asian sites both species can be found in the same levels as in Skhul, Tabun C (Garrard, 1980) and Qafzeh UP (Rabinovich *et al.*, 2004).

The brown bear (*Ursus arctos*)

The brown bear (*Ursus arctos*) is well represented, comprising 192 identified remains and an MNI of 5 individuals (Figure 3). This species is known mainly by a few remains in Mount Carmel and adjacent parts of northern Israel, as in Zuttiyeh, El-Wad B-C, Tabun C-D, Kebara MP (Bate, 1927; Kurten, 1965; Dayan, 1994) and Amud (Rabinovich & Hovers, 2004), in the Mount Lebanon area in Adlun, Masloukh, Kéoué, Nahr el-Joz Joz, Ksar Akil and Abri Bergy (Hooijer, 1961; Garrard, 1980), or in northwest Syria at Dederieyh (Griggo, 2004). Within the Zagros Mountains, the brown bear was described from Shanidar (Evins, 1982), while a bear tooth was recovered as a surface find in Mar Koulian, an
Upper Paleolithic site near Rawansar (Biglari & Taheri, 2000).

The size of *U. arctos* from Wezmeh Cave, compared with finds from the other southwest Asian sites, is shown in Figure 5. The dimensions of the teeth are larger than the extant small-sized Syrian brown bear (*U. a. syriacus*) and place the site among the Middle Paleolithic sites like Ksar’Akil and Tabun C, post-dating the large bear from the Acheuleo-Yabrudian site of Zuttiyeh (Tchernov & Tsoukala, 1997).

**The wolf (*Canis lupus*)**

The wolf (NISP: 176; MNI: 6) is well-represented and, like the hyenas and bears, all skeletal elements are present. The distinction between wolf (*Canis lupus*) and golden jackal (*Canis aureus*) can sometimes be problematic (Payne, 1983). Since teeth are well represented in the Wezmeh assemblage (23.3%), and all of them fall within the range of wolves, it was deduced that this assemblage might largely be attributed to wolf and not jackal. *Canis lupus* was described from Kobeh Cave in the Zagros region (Marean & Kim, 1998) as well as from Palegawra (Turnbull & Reed, 1974) and Warwas (Turnbull, 1975), whereas *Canis aureus* was identified at Bisitun and Tamtama Caves (Coon, 1951), but these are old identifications and a new analysis with a revision of all Zagros canid remains is needed. In the Levant, wolf was present in Ksar ‘Akil (Kurtén, 1965) and Umm El Tlel (Griggo, 1999), while jackal was found at Sefunim (Tchernov, 1984), Ras El Kelb (Garrard, 1998), Geula (Monchot, 2006), Tabun, El Wad, (Garrard, 1980, 1982). Kebara MP and Qafzeh MP, and Hayonim D presented both species (Dayan, 1994; Rabinovich et al., 2004).

**The red fox (*Vulpes vulpes*)**

*Vulpes* was the predominant carnivore species during the later Pleistocene in all southwest Asian sites (Kurtén, 1965; Tchernov, 1988; Dayan, 1994) and the most abundant carnivore at Wezmeh Cave (NISP: 492; MNI: 19), with all skeletal elements represented. The metric and morphological characteristics of the animal are compatible with the red fox (*Vulpes vulpes*), which is distributed today all over Iran.

**The lion (*Panthera leo*)**

Two lions, one young and one adult, are represented by 16 identified remains in Wezmeh Cave (Figure 3). The Iranian Plateau was a suitable territory for lions, which are extinct today in southwest Asia. Historical (13th century) and pre-modern (18th century) references for the occurrence of this species are for southwestern Iran, a region much further to the south of Wezmeh Cave (Etemad, 1985). The last known lion in Iran was reported from the Fars Province in
1944 (Heaney, 1944). During the Mid-Holocene (4th millennium BC) the lion was found to the north of the central Plateau and in southeastern Iran in Qabrestan (Qazvin plain: Mashkour, 2002) and in Tal-i-Iblis (Kerman: Bokonyi, 1967). In the Zagros region during the Neolithic (PPNB), some remains of lion may have been identified at Jarmo (Stampfli, 1983). From Pleistocene sites in the Levant, only isolated remains of lion are known, as at Oumm Qatafa (Vaufrey, 1951), Qafzeh MP and UP (Rabinovich et al., 2004), Sefunim (Tchernov, 1984), Yabrud (Perkins, 1968), Douara (Payne, 1983), Umm El Tlel (Griggo, 1999) and Dederiyeh (Griggo, 2004).

The leopard (Panthera pardus)

A right calcaneus and a second phalanx testify to the presence of leopard. Probably because of its solitary behaviour, this felid is represented in very low frequencies during the Pleistocene. Leopard remains are known from several Middle and Late Pleistocene sites from the southern Levant, such as Adlun, Ksar ’Akil, Geula, Zuttiyeh, Tabun, El Wad E, Kebara UP and Hayonim B (Hooijer, 1961; Kurten, 1965; Dayan, 1994; Monchot, 2006), and from the northern Levant site of Dederiyeh (Griggo, 2004), whereas in the Zagros it was only reported from Bisitun (Coon, 1951) and Yafteh Cave (Otte et al., 2007).

Medium-sized felids

Four remains have been recovered for this group at Wezmeh Cave: a lower canine, an upper canine, a right humeral shaft, and a proximal ulna. It has not been possible to allocate with certainty these teeth and bones to one of the three potential felids present in this area, the lynx (Lynx lynx), the jungle cat (Felis chaus) or the caracal (Caracal caracal). In the Levant the caracal was reported from Geula (Monchot, 2006) and in Douara (Payne, 1983), while the jungle cat was noted as present in Kebara MP (Dayan, 1994). For the Zagros, the lynx and the jungle cat have been reported only from Palegawra (Turnbull & Reed, 1974).

The small felids

Eight elements (two upper canines, one proximal radius, one distal humerus, one fifth metacarpal, one fifth metatarsal and two left third metatarsals) of a small felid testify to the presence at least two individuals. The extant species on the Iranian Plateau are the European wild cat (Felis sylvestris), the Asian wild cat (Felis manul) and the sand cat (Felis margarita). The most widespread species is F. sylvestris, but it has not been possible to identify the species from these bones. F. sylvestris is well represented in many sites during the Late Pleistocene in the southern Levant, such as Kebara MP-UP, Hayonim D, C, B, El Wad and Rakefet (Garrard, 1980; Dayan, 1994), and in Lebanon at Ksar ‘Akil, Abu Alka and Antelias (Garrard, 1980).

Mustelidae/Viverridae

The badger (Meles meles) is represented by 42 remains, from an MNI of 7 individuals. The badger has already been recorded from many sites in the southern Levant including Ksar ’Akil, El Wad, and Kebara MP and UP (Kurtén, 1965; Dayan, 1994), but never in large numbers. In the Zagros, remains of badger are reported only from Palegawra (Turnbull & Reed, 1974).

The beech or stone marten (Martes foina) is represented by a distal part of a radius and a left calcaneus. Very common in the southern Levant during the Late Pleistocene (Tabun, El-Wad, Skhul, Kebara, Hayonim, Sefunim, Shukbah, Geula, Ksar Akil) (Kurtén, 1965; Garrard, 1982; Tchernov, 1984; Dayan, 1994; Monchot, 2006), as well as in the north of Syria in Dederiyeh (Griggo, 2004), the presence of the stone marten in the Zagros area had been attested to since the Late Pleistocene in Shanidar (Reed & Braidwood, 1960) and until the terminal Pleistocene in Palegawra (Turnbull & Reed, 1974). Although this species is associated by many workers with a forest environment, in Iran and Afghanistan M. foina has been found living in rocky areas that were devoid of trees and had very sparse shrubs (Turnbull & Reed, 1974).

Seven remains representing two individuals testify to the presence of the polecat (Mustela
In the Zagros the polecat has been identified only in Palegawra (Coon, 1951; Turnbull & Reed, 1974).

At Wezmeh, one mandible (without teeth), three femora and one humerus are attributed to the mongoose (*Herpestes* sp.). At present, two species are in Iran: the small Indian mongoose (*H. auropunctatus*) and the Indian grey mongoose (*H. edwardsi*). During the Pleistocene the mongoose has only been described in the southern Levant at Geula Cave (Monchot, 2006) and Hayonim E (Dayan, 1994).

### The prey: the herbivores

The medium-large herbivores are dominated by wild sheep (*Ovis orientalis*), wild goat (*Capra aegagrus*) and boar (*Sus scrofa*), followed by red deer (*Cervus elaphus*), aurochs (*Bos primigenius*) and gazelle (*Gazella cf subgutturosa*) (Table 1). The species list indicates that the accumulators of the Wezmeh assemblage focused on wild sheep and goats of the rocky mountain slopes of the Kermanshah region, without ignoring the nearby valley fauna (equids, gazelles, red deer, suids, aurochs). These species are widely encountered among faunal lists in southwest Asia. We refer all the remains of deer to *Cervus elaphus*. All of these bones are larger than those of *Dama mesopotamica*, and no size differences exist to indicate separation into specific groups. The wild boar is generally well represented in the Levant, contrary to the Zagros where it comprises less than 2% of the remains in Pleistocene sites.

Besides these species, five equid remains were found, of which one upper right and a second premolar belong to *Equus caballus*, whereas the other bones (a second phalanx, a sesamoid bone, and a broken canine) could belong to the onager but finer identification was not possible. In contrast to Wezmeh Cave, equids are very well represented at some Zagros sites, such as Palegawra, Warwazi, Gar Arjeneh, Tamtama and Bisitun. In the majority of these cases the remains have been allocated to *E. hemionus*. However, the presence of *E. caballus* was reported in Warwazi, Palegawra (Uerpmann, 1987), and in Tang-e-Barik (Eisenmann *et al.*, in prep.).

The most interesting herbivore is the rhinoceros. The steppe rhinoceros (*Dicerorhinus hemitoechus*) occupied the eastern Mediterranean during the late Middle and Late Pleistocene, while the woodland ‘mercki’ type was absent (Tchernov, 1988). Although the animal is commonly identified in Levantine sites, it is rare in the Zagros and in general on the Iranian Plateau. In Wezmeh a fragment of distal tibia and a fragment of a tooth root were identified. Recently remains have been identified in at least three other sites: Saveh (Mashkour, unpublished data), Qaleh Jough (Darvish & Labbaf Khaniki, 2003) and Qaleh Bozi (Biglari *et al.*, 2006). The latest record of *Dicerorhinus* from the southern Levant comes from the Kebaran layers of Hayonim Cave (Davis, 1982).

Wild goats and sheep are gregarious and tend to remain at high altitudes. Wild goats are extremely agile and prefer crags and rocky cliffs. They can tolerate very arid, cold conditions where vegetation is sparse. Mountains goats would be elusive in the rough terrain of the Zagros Mountains. The presence of red deer and wild boar, with rhino, aurochs or equids, suggests substantial nearby woodlands along with grasslands (for general habitat data for living species, see Lay, 1967; Harrison, 1968, Dorst & Dandelot, 1970; Garrard, 1980).

### The small species

Among the small species, the Cape hare (*Lepus capensis*) is the most abundant animal with 145 remains representing a minimum number of 17 individuals, followed by hedgehog (*Erinaceus* sp.) and Indian porcupine (*Hystrix indica*) in much lower frequencies. Finally, four species of reptiles were identified in the assemblage: the spur-thighed tortoise (*Testudo graeca*), an agamid (*Laudakia* sp.), the grass snake of Montpellier (*Malpolon monspessulanus*) and a viper (*Vipera lebetina*). These reptiles are associated with a hot and dry climate characterised by long summers and an average temperature equal to or above 22°C in July. These species live in cliffs and in low bushes or open forest-type environments with well-insulated soils.
**Human**

A human maxillary right premolar (P³ or possibly P⁴) was found among the faunal remains. The tooth was unerupted at the time of death, since it preserves the complete crown without attrition and ca. 7 mm of the root; modern human standards place its age-at-death late in the first decade of life. Morphologically, the crown falls within the known ranges of variation of Holocene and Late Pleistocene human P³ and P⁴s, including those of both late archaic and early modern humans. The one notable feature of the tooth is its large buccolingual crown diameter (11.1 mm), which places it at the upper limits of Late Pleistocene human ranges of variation and separate from the smaller teeth of Holocene humans (Trinkaus et al., 2008).

**Uranium/thorium dating**

The importance of this assemblage, the absence of artefacts associated with the older faunal remains, and the lack of an in situ archaeological context for most of these remains necessitated radiometric dates on four species: brown bear (*U. arctos*), spotted hyena (*C. crocuta*), wild boar (*S. Scrofa*), and the human (*H. sapiens*). The animal teeth were aged using uranium-series analyses by alpha spectrometry, and the human premolar was analysed by non-destructive gamma spectrometry. These dates were run at the Laboratoire des Sciences du Climat et de l’Environnement (CNRS/CEA, Gif-sur-Yvette, France).

**Alpha spectrometry**

Tooth surfaces were cleaned of detritus by careful scraping. Dentine was separated mechanically from enamel, and each portion was analysed separately. Samples were burned at 800°C for 12 hours to remove organic matter. The ashen samples were dissolved in 8 M HNO₃, then Al nitrate carrier ²³²U–²²⁸Th tracer solutions were added. The adopted method for separation of U and Th, using an ion exchange column, is discussed in full in Wild & Steffan (1991) and methods improved for phosphate-rich samples in Choukri et al. (1994). Thorium and uranium were plated on aluminium foil and counted on an α-spectrometer with a grid-chamber. The ages were calculated using an iterative computer program (e.g. Ivanovich & Harmon, 1992).

In Table 2 the results of the alpha U-series dating of the animal tooth samples are shown. The necessary condition for the applicability of the U-series dating predicts that the samples behave as closed systems during their burial history, a condition that is often violated in fossil tooth samples. Nevertheless, we will hypothesise uranium uptake assimilation into teeth soon after burial, which behaves as in a closed system. With the exception of sample WZ 10, for which the error of the age is very large, all samples gave the same ages for dentine and enamel despite large differences in their uranium contents. Therefore, we propose the dates obtained as the age of uranium incorporation in the mineral system (i.e. a minimum age for the teeth).

**Gamma spectrometry**

Due to the impossibility of dissolving the unique human tooth, we attempted to measure the daughter nucleids of ²³⁰Th, ²³⁵Pa and ²³⁸U, respectively ²²⁶Ra, ²²⁷Ac and ²³⁴Th, by gamma non-destructive spectrometry (Yokoyama & Nguyen, 1981). The sample was directly placed in the well of a very low background, high-efficiency germanium detector located in the ‘Laboratoire Souterrain de Modane’, protected from cosmic interactions by 1700 m of rock overburden (Reyss et al., 1995). The measured specific activities – ²³⁴Th = 2.15 ± 0.10 dpm/g, ²²⁶Ra = 0.52 ± 0.02 dpm/g, ²²⁷Ac = 0.041 ± 0.012 dpm/g – correspond to a ²³⁰Th/²³⁴U age of 20 ka BP and a ²³¹Pa/²³⁵U age of 25 ka BP. Taking into account the numerous hypotheses and the large data uncertainties, these dates are approximate.

**Preliminary taphonomic considerations**

In recent decades a strict methodology for the study of taphonomic processes has been developed, allowing a better understanding of the origins of bone accumulations and site formation processes in extenso (Brugal et al., 1997; Pickering,
Without entering into the details of the taphonomic study, which will feature in a forthcoming work, several points can be noted in the Wezmeh assemblage:

(1) Wezmeh Cave has a rich faunal diversity (Margalef Richness Index: 4.55; Shannon Diversity Index: 3.80, E: 0.88 (Magurran, 1988)) with respect to other Iranian/Zagros sites, as well as more generally compared with other southwestern Asian Late Pleistocene sites. This applies especially to the carnivores, which make up 79.7% (n = 1734) of the NISP and 74.1% of the total minimum number of individuals (carnivores and ungulates). This is an unusually high frequency compared with recent and fossil hyena dens in South Africa (Cruz-Uribe, 1991), the Levant (Kerbis-Peterhans & Horwitz, 1992; Monchot, 2006) or various Pleistocene caves in Europe (Marra et al., 2004).

(2) The bones are on the whole well preserved, with few breaks other than fresh ones incurred during looting. It is likely that the looting masked the earlier carnivore breakage, since the breakage patterns of the long bones indicate that the majority occurred on dry bones and are of post-depositional origin (Villa & Mahieu, 1991).

(3) The frequency of carnivore marks (gnawing, crushing, etc.) on all bones, whether carnivore and herbivore, is very low (ca. 5%), suggesting that the carnivore remains do not represent prey but rather the predators.

(4) The skeletal representation for carnivores (bear, hyena, wolf and fox) is uniform (with vertebrae and ribs), while limb extremities (metapodials, phalanges) are more common for the herbivores. It is possible that animal species that den in caves or use them frequently have a higher probability of dying in situ, leading to a more complete skeletal representation. The absence of ribs and vertebrae, and even cranial elements, for the large herbivores is probably due to these elements being the last remaining on a kill site after the passage of hyenas. Limb extremities are largely intact and were not consumed by carnivores.
Carnivores are primarily represented by adult individuals, especially young adults. This differs from the age profile of a carnivore maternity den where numerous remains of neonates and juveniles are found (Kerbis-Peterhans & Horwitz, 1992; Brugal et al., 1997).

Conclusion

Wezmeh Cave was therefore repeatedly occupied by a variety of carnivores in the Late Pleistocene. It is noteworthy that it does not follow the usual parameters for a den pattern. Even though the cave was looted and the original positions of the bones are not known, the absence of immature bones within the assemblage, despite sieving with a fine mesh, is unusual. The cave was most probably used more as a shelter for several carnivore species at different times, rather than as a long-term den.

On the basis of these preliminary studies the following scenario can be proposed: ca. 70 ka BP the use of the cave commenced with hibernating bears, some of whom died in the cave. Following this, many carnivore species, amongst them the spotted hyena, frequented the cave. Parallel to these occupations, the small carnivores took advantage of the meat available in the cave and began frequenting the cave, while at the same time serving as prey. As suggested by the radiometric dates, these occupations continued during several millennia, certainly after oxygen isotopic stage 5.

The absence of anthropic activity in Wezmeh, at least during the Late Pleistocene, does not fit the scheme of an archaeological site. The presence of the human tooth can be interpreted as the result of carnivore hunting/scavenging, a case often encountered in Late Pleistocene dens in Europe (e.g. Rochelot, Guattari, Unikoté, and Rochers-de-Villeneuve; Tournepiche et al., 1996; Giacobini, 1990-91; Michel, 2004; Beauval et al., 2005). Independent of their origin, the Wezmeh Cave human tooth can be added to the human remains found in Bisitun and Shanidar (Trinkaus, 1983; Trinkaus & Biglari, 2006) that confirm the presence of humans in this part of the Zagros during the Late Pleistocene.

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