THE GODREVY DOG; EARLY CANINE OR LOST PET ?

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Crisp, G., Pirrie, D., Shail, R.K. and Sabin, R.C. 2001. The Godrevy dog; early canine or lost pet ? *Geoscience in south-west England*, **10**, 000-000.

During sampling of the late Devensian St. Loy Member of the Penwith Formation at Godrevy, Cornwall, several ribs and vertebrae were discovered within the cliff face. The visible bones appeared in context with the surrounding geology with no evidence for later site disturbance or burial. During the excavation the skeleton was entirely enclosed within the coarse grained head deposits. The skeleton was articulated and nearly complete and is identified as *Canis familiaris*, the "domestic" dog. The recovery of this skeleton from the St. Loy Member of the Penwith Formation, generally regarded to be of mid to late Devensian age, is scientifically problematic. The accepted age for the late Devensian is 12-15,000 years BP. The oldest known domestic dogs are dated at about 10,000 years BP, although the burial of a dog or wolf puppy with a human skeleton from Israel 12,000 yrs BP is taken as early evidence of domestication. There are three possible interpretations: (1) the St. Loy Member of the Penwith Formation is younger than previously thought; (2) that Godrevy dog is a very early domestic dog; (3) that it is possible to incorporate a rcent articulated dog skeleton into Quaternary head deposits without any signs of physical disturbance at the site. Dating of the right radius bone by accelerator mass spectrometry has given a likely age for the skeleton of between 1620 AD and 1680 AD. Thus a 17th century domestic dog has been enclosed within Devensian coarse grained head deposits with no signs of disturbance to the site.

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INTRODUCTION

Fossil mammal remains are very rare in the Quaternary sedimentary record of Cornwall. Several early accounts describe deer and whale bones recovered from "marine" Holocene sediments within both the Pentewan Valley near St. Austell (Winn, 1839; Flower, 1872) and the Carnon Valley (Couch, 1865a). Couch (1865b) in a description of the submerged fossil forests around the Cornish coast suggested that deer and elk fossils were common in association with the fossil forests, with samples from Whitsand Bay, to the east of Looe, Polperro, Lantivet Bay, near Fowey, Carnon Valley, Pentewan, Marazion and at Land's End. However, all of these occurrences are within Holocene sediments; no mammal fossils have been reported from the underlying Devensian sediments. During regional mapping of the clast composition of the Devensian sediments in west Cornwall, a number of vertebrae and ribs were observed weathering out of the St. Loy Member of the Penwith Formation at Godrevy, Cornwall (Figure 1). In this paper, the vertebrate skeleton recovered from this site is described and mechanisms whereby a 17th Century domestic dog was enclosed within Devensian sediments without any signs of site disturbance are considered. The implications of this work for both archaeological and geological studies are considered.

REGIONAL SETTING

Godrevy is one of the most important Pleistocene sites in south-west England (Campbell, 1998; Campbell *et al.,* 1999a) and was first described in early studies by De la Beche (1839), Whitley (1866, 1882) and Ussher (1879). The Devonian Porthtowan Formation is unconformably overlain by conglomerates and locally cemented sands which were assigned to the Godrevy Formation (Scourse, 1996) which has now been revised as the Godrevy Member of the Penwith Formation (Campbell *et al.,* 1999b). At this locality, dating of the Godrevy Member based on amino acid ratios measured from samples of *P. vulgata* has suggested a correlation with either oxygen isotope stage 7 (pre-Ipswichian post Hoxnian temperate stage) (Bowen *et al*., 1985; Scourse, 1999) or with the younger oxygen isotope stage 5e (James, 1995). It is possible that several different aged raised beach deposits are superimposed at the Godrevy site (James *pers. comm*., 2001). This dating suggests that the overlying head deposits may have accumulated during several

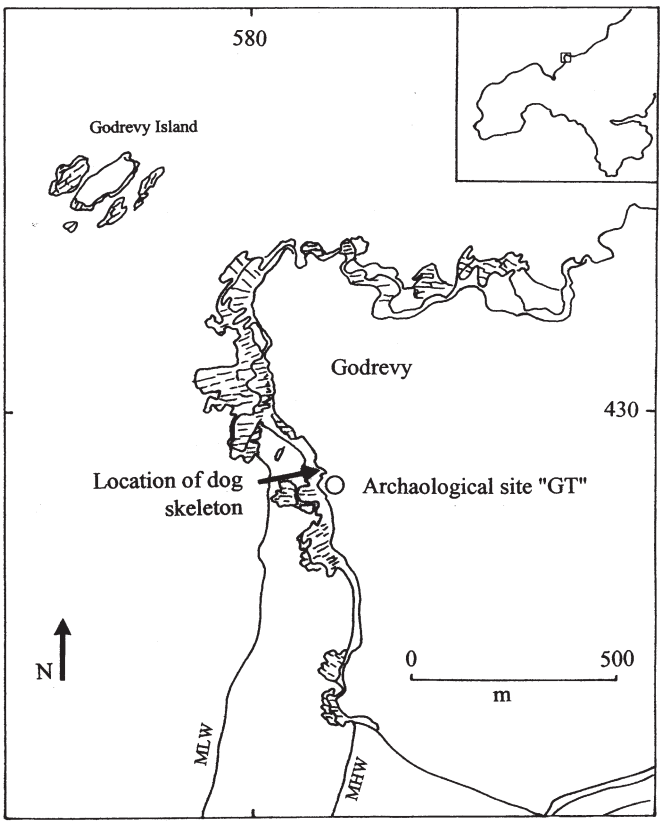

Figure 1. *Map showing the location of the studied section at Godrevy. The approximate location of Mesolithic and Romano-British sites in the area is also indicated (based upon Thomas, 1958).*

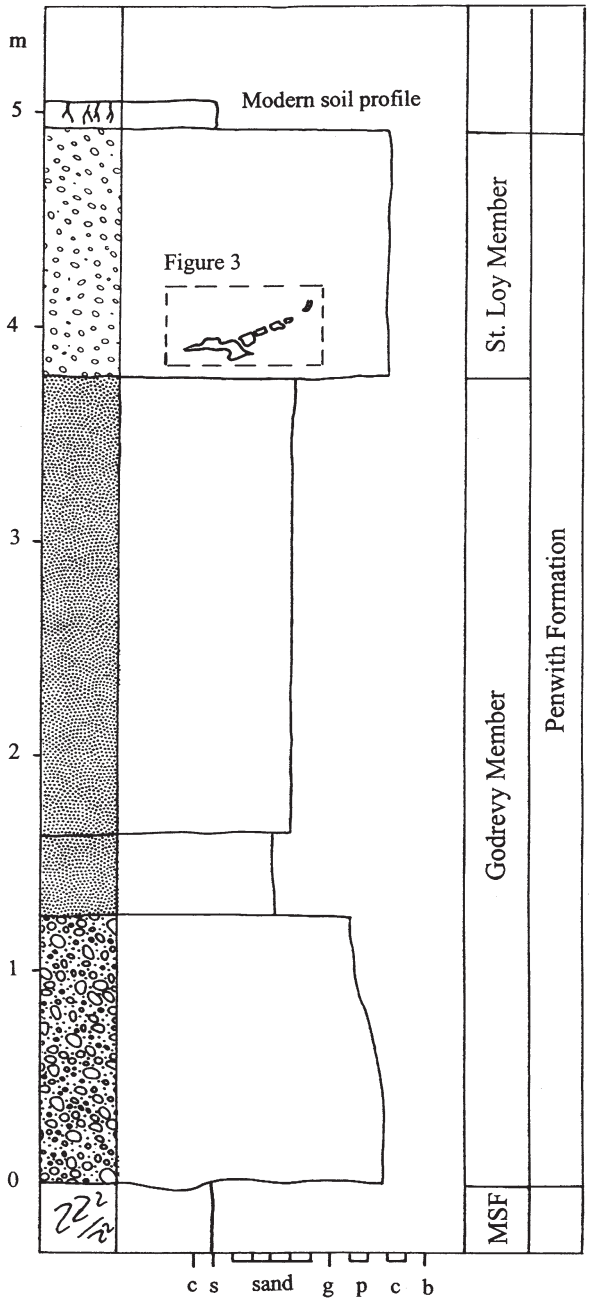

Figure 2. *Sedimentary log through the studied section showing the location of the skeleton. The lithostratigraphy for the section is also shown (after Scourse, 1996; Campbell, 1998; Campbell et al., 1999a). PF - Porthtowan Formation.*

different Pleistocene cold stages (Campbell, 1998). The Godrevy Member is in turn overlain by the head deposits of the St. Loy Member (Penwith Formation) which comprise poorly sorted coarse grained conglomerates (Campbell *et al*., 1999b). This member is largely considered to have a periglacial soliflucted origin and is generally regarded to be mid to late Devensian in age (Scourse, 1999; Campbell *et al.,* 1999b).

A simplified graphic sedimentary log through the Penwith Formation at Godrevy (SW 5815 4315) is shown in Figure 2. The measured section at this site was 5.04 m thick. 1.22 m of well rounded pebble to cobble sized clasts, predominantly composed of metasediments and vein quartz are overlain by 2.58 m of medium to coarse grained unconsolidated sands. The lower 0.39 m of the sands are medium grained and poorly sorted with a clayey matrix; these are in turn overlain by poorly sorted coarse grained sands which are poorly exposed. Together this lower section represents the Godrevy Member. The contact between the Godrevy Member and the overlying St. Loy Member is sharp and planar at the sampling site although laterally along the cliff section at Godrevy it is locally loaded. The St. Loy Member is 1.14 m thick and comprises angular clast supported conglomerates with a clayey matrix. The Penwith Formation is overlain by a 0.1 m thick modern soil profile. The skeletal remains were initially found 0.4 m above the base of the St. Loy Member (Figure 3) although during the subsequent excavation the skeleton was found to be rotated and slightly inclined from a horizontal plane into the cliff.

At this location, the skeletal remains are present within a 3 m wide slump zone with a small active stream through the middle of the section. The block in which the skeleton was recovered was slightly displaced and rotated, yet the stratigraphy within the block could be matched directly with that on either side of the minor slope displacement.

The excavation

The Godrevy section is an SSSI and the land is owned by the National Trust. Prior to excavation, permission to work at the site was sought from the National Trust and a methods statement was agreed with English Nature. Archaeologists from the Cornwall Archaeological Unit and also representing the National Trust visited the site and considered the remains to be in context with the surrounding stratigraphy with no evidence for site disturbance. The skeleton was articulated, but rotated, so that the head and upper part of the spine were rotated round into the cliff section. The skeleton was entirely enclosed by coarse grained head deposits which appeared identical to the surrounding sediment (Figure 3). During the excavation approximately 80% of the skeleton was recovered, including the skull, the majority of the vertebrae and most of the fore and hind limbs (Figures 4 and 5). Some rib and limb bones were recovered from a recent talus deposit under the cliff section and it is likely that the remaining 20% of the skeleton was lost during weathering of the cliff section prior to the excavation. No other organic remains or "exotic" material were found during the excavation.

Sample identification and description

The recovered skeleton was examined at the Natural History Museum, London, and identified as *Canis familiaris* - the "domestic" dog (A. Currant, *pers. comm*., 2000). Examination of the skull showed that the outer layer of compact bone on the surface of the skull has been degraded through abrasion by sediments, probably as a result of post-depositional compression (Figure 5). However, damage to the bone caused by the actions of fine plant root matter can also be seen. Root matter was also found inside the brain case after removal of the coarse grained sediment, which was densely packed into the cranial cavity. This evidence, plus the presence of root matter on many of the bones of the axial and appendicular skeleton, suggests that exposure of the semi-articulated remains in, or on, organic deposits supporting plant life, must have taken place either before enclosure in the head deposits or by root systems penetrating through the head deposits after deposition. The nature of the sediment removed from the cranial cavity via the foramen magnum suggests that the deposits must have been comparatively 'mobile' to pass through such a relatively small aperture. However, there were shale clasts measuring up to 6 mm in length by 3 mm in width mixed in with the sediment removed from the skull.

The permanent dentition on the skull is fully erupted and shows signs of attrition (Figure 5). There are no visible signs of dental pathology. In the region of the basi-sphenoid bone in the skull are two small apertures, approximately 3-4 mm in diameter (Figure 5). The sides of the apertures are smooth with some remodelling of the bone, and appear to be pathological in nature (i.e. caused by disease, infection or injury) rather than the result of post-depositional or excavation damage. Few post-cranial elements have survived intact, though the diaphyses of most of the long bones are relatively complete. Sections of the post-cranial skeleton, including parts of the pelvis and left femur, show areas of green 'staining' which may be the result of algal growth.

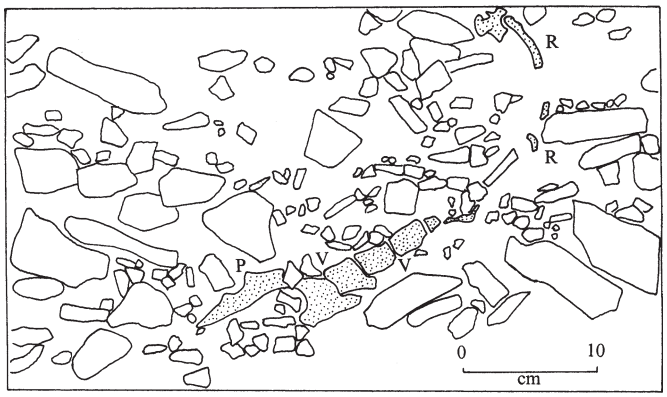

Figure 3. *Schematic diagram showing the field appearance of the skeletal remains weathering from the cliff section at Godrevy prior to excavation. The skeletal remains were enclosed within coarse clasts of vein quartz and Devonian metasediments in a poorly sorted clayey matrix. P - pelvis, V - vertebrae, R - rib.*

The morphology of the Godrevy dog skull (Table 1) was compared with both a 2000 year old dog skull from a Roman excavation and the skull of a pariah dog, an extant form of ancient dog from India which is comparable with small dog skeletons found at numerous prehistoric sites. Whilst the skull was broadly comparable with both the Roman dog and pariah dog, it was still considered possible that the skull was much younger in age and had been introduced (J. Clutton-Brock pers comm. 2000). In terms of the overall size of the Godrevy animal, its morphology is comparable with that of the fox terrier, a small to medium sized dog that grows to approximately 40 cm high at the withers.

Age dating

Wolves found in archaeological excavations probably represent the early stages of domestification and are generally regarded to be the wild progenitor of the domestic dog (Davis and Valla, 1978; Benecke, 1987). The earliest known dog remains are based upon a mandible dated at about 12,000 BP from the Zagros Mountains, Iraq (Turnbull and Reed, 1974) along with the remains of a wolf or dog puppy associated with a human burial dated to 12,000 BP in Israel (Davis and Valla, 1978). In the UK the oldest known domestic dog is from Star Carr in Yorkshire (Degerbol, 1961) which is dated at 9538±350 BP (Davis and Valla, 1978). Thus the identification of the skeleton as being a domestic dog raises a significant scientific problem, for which there are three possible interpretations. (1) If the skeleton is in context with the geology, then the St. Loy Member of the Penwith Formation would have to be younger than previously thought. (2) If the age dating of the St. Loy Member is correct then the Godrevy dog is a very early domestic animal. Previous archaeological studies had recognised a Mesolithic site at the cliff top very close to the location of the dog skeleton (Thomas, 1958). Indeed, Thomas (1958) stated that the Mesolithic cliff top site at Godrevy was a flint-chipping floor, which at that time was partially exposed "in the cliff edge". A Romano-British homestead enclosed within an encircling bank is also described by Thomas (1958) from this site, hence there is evidence for lengthy nearby human occupation (see Figure 1). (3) The third interpretation is that the skeleton is much younger and is not in context with the surrounding geology. This would indicate that it is possible to enclose an articulated dog skeleton into coarse grained head deposits without any signs of physical disturbance at the site.

To test these three hypotheses a bone sample was taken from the right radius and was dated using accelerator mass spectrometry (AMS) at the Oxford University Radiocarbon Accelerator Unit (sample number OxA-9992). The sample gave an uncalibrated date in radiocarbon years BP (before present - AD 1950) of 251±30 and had a $d^{13}C$ value of -18.9‰. Isotopic fractionation has been corrected for using the measured $d^{13}C$ value quoted. When calibrated using the OxCal program (Ramsey, 1995) using atmospheric data from Stuiver *et al*. (1998) an age of 1620 to 1680 AD is given at 95.4% probability (Figure 6).

Discussion

The Godrevy dog skeleton is therefore dated at between 1620 and 1680 AD yet enclosed within head deposits of probably mid to late Devensian age. The skeleton was articulated which implies that soft tissues were present around the skeleton when it was incorporated into the sediment. The lack of evidence for scavenging and disarticulation also implies that the animal was not present on the land surface for any significant length of time post mortem. However, the sediment removed from the skull along with root matter on many of the bones, suggests that the semi-articulated remains were on, or enclosed, within organic deposits prior to enclosure within the head deposits or that root systems penetrated through the skeletal remains after inclusion within the head deposits. Thus a mechanism is needed whereby an animal can be incorporated within the coarse grained sediments after death without disrupting the local stratigraphy. There is however, no way to test the potential hypotheses, consequently the discussion is, by its very nature, speculative.

There was no evidence at the site that the animal had been buried. The overall sedimentological profile of the section surrounding the skeleton was identical to the adjacent sections, suggesting that if a pit had been dug, then the sediment was replaced in stratigraphic context. An alternative interpretation may be that the dog entered an animal burrow and became trapped and decayed *in-situ*, and the sediment subsequently collapsed and compacted around the skeleton. The very coarse grain size of the head deposits would preclude burrowing activity by rabbits or hares which today burrow into the recent wind blown dune systems forming the nearby Gwithian Towans. However, it is broadly conceivable that a badger may be able to burrow in such coarse grained sediment and that coastal recession has subsequently exposed this burrow within the current cliff profile.

As described above the sample location is within a narrow valley that leads to a gulley incised into the wave cut platform of Devonian metasediments. The area in which the skeleton occurred was slightly displaced within a ?rotated land slipped block which retained its stratigraphical integrity. Landslides and rotational failures are common within the Quaternary sediments along the Cornish coastline. A possible alternative explanation for the inclusion of the skeleton within the head deposits involves a three stage process related to coastal erosion. During slope failure tension cracks may develop landward of the cliff profile, subsequent back rotation during slope failure may cause the closure of the tension crack as the block back rotates. The block may retain stratigraphical integrity but undergo down slope translation. It is conceivable that an animal may fall into and become trapped within a tension crack, which subsequently closed during back rotation apparently incorporating the skeleton

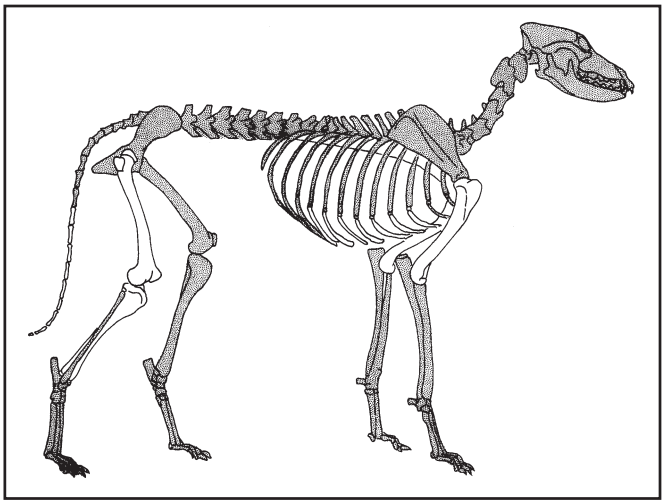

Figure 4. *Diagram showing the typical morphology of the domestic dog. Shaded areas show the skeletal elements recovered in this study.*

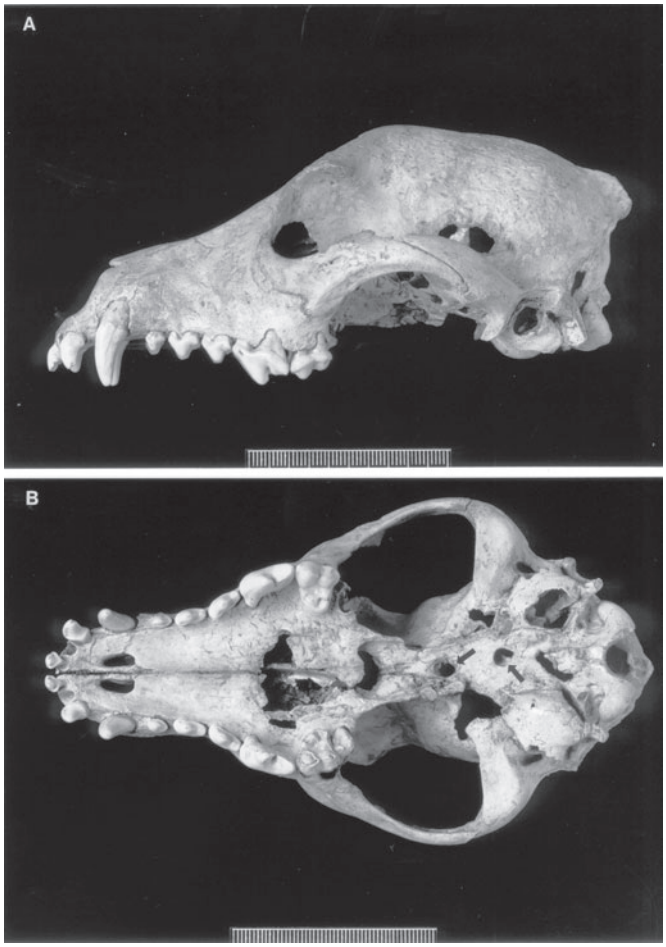

Figure 5. *Photographs showing the skull of Godrevy dog. (a) Side profile of the skull; note that the dentition is fully erupted. (b) View of the underside of the skull. Note the two small apertures in the region of the basi-sphenoid bone (arrowed). These are smooth sided and appear to be pathological in origin. Scale bar in both photographs is in mm.*

Basic dimensions of the skull	millimetres
Total length of skull	153.5
Condylobasal length	142
Basal length	134.5
Upper neurocranium length	80
Facial length	73.5
Zygomatic breadth	89
Greatest neurocranium breadth	53.5
Frontal breadth	45.5
Least breadth of skull	34.25
Least breadth between orbits	31
Greater inner height of orbit	26.25
Greatest breadth of foramen magnum	16.5
Height of foramen magnum	14.5
Greatest mastoid breadth	54.25
Skull height without sagittal crest	44.5
Length of cheek tooth row	52
Length of molar row	16
Greatest palatal breadth	53
Least palatal breadth	30.25
Breadth at canine alveoli	32

Table 1. *Basic dimensions of the Godrevy dog skull (all measurements in mm, following Von den Driesch, 1976).*

within the head deposits. However, for this mechanism to be viable it implies that the rate of erosion of the Quaternary section at Godrevy is low as tension cracks are unlikely to have developed more than a few metres back from the cliff line. If we assume that the tension crack is unlikely to have developed more than 5 m back from the position of the cliff line in c. 1620 then a coastal recession rate of 1.3 cm/yr would be suggested. If the tension crack was closer to the c. 1620 cliff line then a lower rate of coastal recession would be predicted. Whilst it is impossible for us to test these hypotheses it is considered that the most likely model is that of inclusion within a rotated block during cliff failure in the 17th Century.

IMPLICATIONS

It could be argued that the presence of a 17th Century dog skeleton within Devensian sediments is not worthy of documentation. However, there are clear implications of this discovery for both archaeological and geological studies. No aspect of the skeleton or the surrounding sedimentology indicated that a much younger animal had been incorporated within significantly older sediments. If the skeletal remains had been of a typical late Devensian mammal such as the red fox (e.g. Stuart, 1995) both the geology and the fossil taxa would have been compatible. How often are vertebrate samples AMS dated to confirm that they are compatible in age with the assumed age of the sediments ? In addition, AMS dating has only been widely available in recent studies; prior to the development of this method the skeletal remains themselves would have been the key to effectively providing the biostratigraphic control on the age of the sediments. Mesolithic and Romano-British sites have been excavated within a few metres of the skeleton site; it is entirely possible that the dog skeleton could equally well have been incorporated within the archaeological evidence again providing an erroneous occurrence. This study suggests that the context and significance of any fossil occurrence within the Quaternary coastal sections must be treated with caution unless there is clear dating control to confirm the age relationships of the skeletal remains and the associated sediments. It is unfortunate that many of the skeletal remains described from the Holocene sediments in Cornwall by earlier workers have subsequently been "lost" as AMS dating would provide an unambiguous solution to their age and true geological significance.

ACKNOWLEDGEMENTS

We are grateful to the Phil Dyke and Bill Makin from the National Trust for permission to excavate the skeleton at Godrevy and to Andrew McDouall of English Nature for their support. Dr Andy Currant at the Natural History Museum, London, is thanked for providing the initial identification of the skeleton, as is Dr

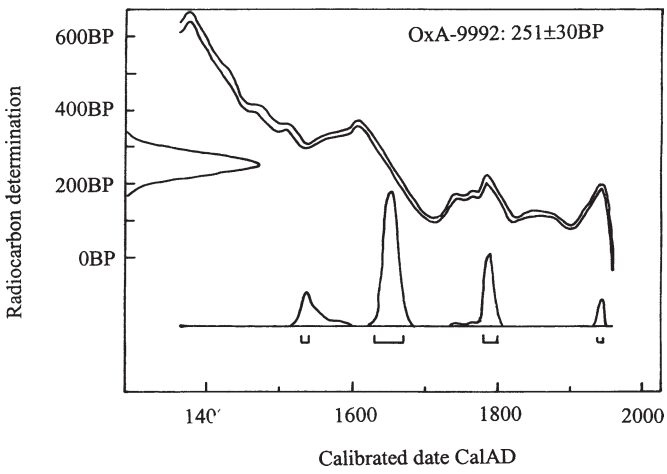

Figure 6. *AMS dating results showing the most likely age for Godrevy dog to be between 1620 and 1680 AD.*

Juliet Clutton-Brook for her comments. Dr Matt Power, Steve Pendray and Angie Crisp provided assistance during the excavation. We are grateful to Steve Hartgroves of the Cornwall Archaeological Unit for site visits. Thanks to Nicholas Cormack, volunteer conservator at the Natural History Museum who carried out cleaning and conservation of the skeletal remains, and Vicki Lambert, Department of Archaeology, University of Exeter, for helping with morphometric analysis of the skeleton. Staff at the University of Oxford radiocarbon laboratories provided the critical dating control. Dr Les James is thanked for his review of the manuscript.

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