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The Highland Environment of Ḥimyarite Ẓafār (Yemen): Neo-Geographic Determinism?[4]

Introduction

The history of the Ḥimyarite tribal confederation (110 BCE–525 CE) centres on the Yemenite highlands) and the early capital at Ẓafār. Measuring some 110 hectares, Ẓafār is the second largest site in Arabia, following Ma'rib (Yule 2007)[5]. The environment including agriculture is many-facetted and has been dealt with for the Bronze Age in the Yemen (Charbonnier 2008, summarising: Edens 2005, Wilkinson 2003) but rarely for the Ḥimyarite age (exceptions: Lewis 2005; Franke et al. 2008) in the highlands (2000–3000 m a.s.l.). In addition, new and old literature regarding traditional agricultural geography has been omitted in recent research (such as Kopp 1981; Yule et al. 2007; Franke et al. 2008) the latter two which remained in the press long after submission. In what follows, the writers briefly restate the relevant data regarding the natural and cultivated resources combined with theory in order to update the discussion of the environmental situation.

The interaction of man and environment during the Ḥimyarite period is controversial: Late, that is in the 6th century, the truly amazing series of calamities borders on little short of the divine. New data regarding the nature of world-wide calamities, be they volcanic outbreaks, comet impacts, droughts, or plagues, are amply recorded in 6th century Byzantine sources (Meier 2003), but only exceptionally in South Arabian ones. Does the Ḥimyarite state and its subsequent manifestations prior to Islam collapse as a result of a "decadent" society, military activity, or natural events?

Pioneer early geographic determinists include such notables as Edward Gibbon (1776–1789), Leone Caetani (1911) and Ellsworth Huntington (1924). Caetani described for early Yemen demographic expansion running up against water shortage and triggering large-scale migrations. A new research generation yielded concrete climatic data, which first made climate modelling possible. Complementary historic data also caused a reaction

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[4] We thank the Yemeni authorities for permission to conduct work at Ẓafār from 1998 to 2009. We thank the German Research Council (DFG) which bore the expenses since 2006 and other foundations before it. Proper gratitude can and shall be expressed in the final report (in preparation). Fischer collected the botanical data in 2008. Rösch collected that in 2006 and studied the entire complex. Yule wrote the summary discussion. Hartmut Müller of the Institute for Spatial Information and Surveying Technology of the University of Applied Sciences in Mainz for support and for 'lending' us Ingo Buchwald und Tobias Schröder for our survey. We are indebted to Walter Müller, who corrected the transliteration and made salient points in the discussion. Ueli Brunner also kindly went over a version of the text.
[5] Since this area settlement density is uneven, like the next largest site, Maṣna'at Māriya (c. 96 ha) it cannot simply serve as a base for a population estimate. K. Lewis's description of Maṣna'at Māriya as being larger in surface than Ẓafār (2005: 358) preceded her mapping of the escarpment and the reading of our preliminary reports. She questioned whether Ẓafār was the centre of the political landscape (p. 155). Numerous Greek, Sabaic and Arabic texts, as well as archaeological finds, give a clear impression of the political and cultural importance of Ẓafār as the capital, which cannot be tampered with.

against early geographic determinist theory. Nowadays, the dichotomy between historic and climatic factors is understood to be a monocausal over-simplified path of interpretation.

Palaeoenvrionment

Climate and physical relief combine to define agricultural zones (Fig. 1). Yemen's western mountain face offers some of the most spectacular mountain landscape in the region. The soil in the southern part of this zone arises from mineral-rich trap rock with some loess deposits which combine with the highest precipitation (Kopp 2005: 36). A few years ago there were no reliable climatic data for the Yemen (Kopp 1981: 34). Today data exist for the amount and distribution, although experts emphasize the minimal nature and potential shortcomings of the sample (Fig. 2). South Arabia has a smaller and larger summer monsoon in March and August–September respectively. In the highlands precipitation peaks at 1000 mm per year a few kilometres south-west of Ibb and somewhat less south-west and north-west of Ṣan'ā'. High rainfall coincides with more extensive terracing. In the immediate area of Ẓafār some 500 mm per year are estimated. Rain fed agriculture allows for annual single-cropping, and sometimes more in different parts of the country (Lewis 2005: 96). Below 250–500 mm rain per year irrigation is required, but this border is hypothetical and (Kopp 2001: 114; 2005: 106) can be found hardly anywhere in South Arabia. The less the rainfall, the more critical its reliability for the inhabitants. In some years there may be no harvest. The amount of labour invested also plays a great role in ensuring productivity. But what about the rainfall in the early 1st millennium CE?

Geoarchaeological study began in the highlands related to the late Pleistocene and Holocene (Wilkinson 1997: 834) in the mid 1990s. The high intermontane plains contain traces of lacustrine and marsh as well as higher amounts of phytoliths and sediments giving indication of a high humidity in mid Holocene times (Wilkinson 1997: 845). Bridging the 5000 year gap until the late Holocene is no mean feat. Suffice it say, the climate became similar to that today. Prior to significant human habitation, the mountain plains seem to have been densely wooded (Hepper and Wood 1979: 67; Wilkinson 1997; cf. Brunner 1999: 38–39). Few data are locally available until modern times. Although never archaeologically researched prior to restoration (Brunner 2006), the Ṭawīla valley tanks (singl. birke) in 'Adan date perhaps to the Ḥimyarite age – a later dating being improbable given a lack of a major organising authority (Doe 1971: 126 fig. 6). Probably by Ḥimyarite times this excellent port had attained some size and stature, by virtue of its key location in regional and interregional trade. Reportedly it had a church. One wonders why the 90.000.000 litre capacity of the tanks is as high as it is given the present-day dryness. In the early 1st millennium CE it might have been higher.

At Ẓafār a higher population during the early (110 BCE–c. 270 CE) and empire period Ḥimyar (270–525) suggests, although weakly, a higher local agricultural potential enabled by higher precipitation. Evidently most of the food was imported to the capital. In their research zone, the Chicago team located 37 major early historic dams (Lewis 2005: 196), by no means the poetic 80 attributed Ẓafār in the traditional literature (Ibid. 2005: 199; Wissmann 1964: 312). The climate during the Ḥimyarite age seems similar today's (see below). Drawing a parallel with neighbouring Axum, possibly the climate was slightly wetter than now. In Nubia the annual floods began a long-term rise early in the Christian era with episodic, destructive floods between about 600 and 1000 CE (Adams 1965). Butzer cites various indicators in support of greater rainfall, such as the flood gauge readings at Cairo, beginning in 622 which are more precise (1981: 476–477). Butzer also suggests cyclical droughts would easily have had a highly disruptive effect, as an alternative to the increasing dehydration theory advocated by Caetani.

A further source derives from numerous temperature reconstructions made for the northern hemisphere mean changes over the past two millennia based on estimated radiative forcing histories. The so-called hockey stick profile (Mann et al. 2003, fig. 4) shows a slightly cooler temperature until the late 20th–21st centuries when it suddenly increases. A basic climatic homeostasis is evident until 800–1300 CE.

Irrigational technology

Rain fed agriculture dominates in the highlands. Field terracing is necessary to retain water and soil and to increase the cultivation surface. This can be dated by means of stratified radiocarbon samples as early as 4000–5000 years ago – then already a main landscape feature (Wilkinson 1997: 842). During the Ḥimyarite age, increasingly the natural environment yields to agriculture development. Well irrigation is a recent development in the highlands (Lewis 2005: 190).

During the Ḥimyarite age, heavy stone walls built across valleys become important factors in landscape development. Similarities in their masonry with dated structures of this period, provide a means of dating. Their function is open to different interpretation, given a lack of ethnographic parallels (Lewis 2005: 192) and constructional alterations in their long use-history. Clearly they preserve soil and water (e.g. Weisgerber and Yule 2003 for a similar case in Oman). The best example is Ẓafār/Maʾǧil al-Šaʿbānī (Fig. 3) – an intact reservoir presently with a volumetric capacity of 30700 m^3 and with two large Ḥimyarite-style 'dams' to the east and west. Prior to its filling up with alluvium this would have been more. Today, that to the east has developed into a field retention wall with old, non-functioning sluices. But the principle is clear: One floods the fields knee-deep and lets the water out of the reservoir as is needed. Today, this reservoir provides water for 46 fields (Barceló et al. 2000). The terrestrial survey yielded different results from Barceló's traced sketch maps (Schröder 2008: 55 fig. 39) which arose through the mapping method. But that in the west retains water during the rains as in antiquity.

Sources for Ḥimyarite Agriculture

Botanical remains were recovered from Ḥimyarite Ẓafār (Franke et al. 2008) and al-Aḏlaʿ, the satellite settlement 2 km east of Maṣnaʿat Māriya (Lewis 2005). Only 40 km separate the former two sites. The two sites differ in character and in their sampling procedure. The trench in the al-Aḏlaʿ dwelling measures 36 m^2 (Lewis 2005, 252 fig. 8.1) and that in Ẓafār's Stone Building in 2006 was c. 50 m^2.

The al-Aḏlaʿ context jibes roughly with those from the Stone Building in terms of radiocarbon dating[6]. Lewis refers to two groups of Ḥimyarite pottery: the earlier red ware and a second complex such as at al-Aḏlaʿ. The ceramics from al-Aḏlaʿ include a small percentage of burnished or red slipped and polished fine serving or special use wares, but the bulk of the assemblage is made up of sherds from plain, thick, oxidized red ware vessels in utilitarian forms such as storage jars, platters, cooking pots and large bowls. Most of the fabrics have mixed grit temper, although some wares are partially or entirely chaff tempered (see also Gibson and Wilkinson 1995: 172–175). At Ẓafār in the Stone Building there is very little polished red ware and it seems thus that al-Aḏlaʿ is earlier. A comparison

[6] See the radiocarbon table on p. 354 table B.2 for al-Aḏlaʿ. The five dates scatter: at σ2 calibrated they include: 770–400 BCE, 70–250 CE, 240–420, 330–540, 400–570.
From the Stone Building at σ2 calibrated: 199 BC-047 AD, 018 BC-215 AD, 003 AD-068 AD, 008 AD-214 AD, 077 AD-214 AD, 126 AD-326 AD, 128 AD-237 AD, 133 AD-332 AD, 136 AD-336 AD, 139 AD-333 AD, 146 AD-338 AD, 156 BC-084 AD, 164 BC-067 AD, 172 AD-388 AD, 185 AD-340 AD, 232 AD-338 AD, 233 AD-331 AD, 240 AD-385 AD, 243 AD-359 AD, 244 AD-395 AD, 247 AD-381 AD, 251 AD-400 AD, 255 AD-394 AD, 260 AD-430 AD, 393 AD-534 AD. The early dates derive from the foundations, the later ones from the debris inside. These 25 determinations and others are still under study and thus are cited in abbreviated form.

of the pottery otherwise indicates more clearly the socioeconomic dimension of both sites. Exotic pottery and a heavy proportion of footed storage jars and fine ware show a more urban setting at Ẓafār (cf. Table 1, Fig. 4).

Ẓafār, Stone Building	al-Aḍla' settlement
organic mixed with mineral temper	mixed grit with chaff
organic & sand temper	chaff tempering
58% wheel-turned	no data
surface most untreated	some red-slip and polishing
c. 20% Roman amphoras	no imports
large storage vessels (foot lugs)	jars with externally thickened rims
bowls, open, globular	horizontal handles
Jars	carinated bodies
necked jars	lid seated rims
Plates	ledge-rimmed bowls
ring bases	high ring-bases
horizontal lugs, often pierced	flaring bowls
glazed surface treatment	-

Table 1. The pottery from the Stone Building has significant similarity with that from the al-Aḍla' site but also differences which require explanation.

The two contexts differ in their character: Al-Aḍla' is a non-elite dwelling (Lewis 2005: 355) and the large Stone Building belongs in or near the royal palace Raydān in Ẓafār; its exact use-identification eludes us. The cemetery zc01 contains the mortal remains of a non-elite population to judge from the size and shape of the graves, in addition to the grave goods (Yule et al. 2007: 488–495). They may date to the empire and late/post periods (525–>632).

major cultivated grain crops	other Poaceae (grasses)	Fabacaeae (legumes)	fruit, oil, fiber & wood	Miscellaneous
Hordeum vulgare	Eragrostis cf. Tef	Lens culinaris	Vitis vinifera	Portulaca cf. Oleracea
Triticum dicoccon	Setaria sp.	Medicago sp.	Prunus persica	Chenopodium Spp.
Triticum sp.	Panicum sp.	Indigofera sp.	Prunus cf. Armeniaca	Amaranthus Spp.
Sorghum cf. Dura	Eleusine sp.	Astragalus sp.	Ficus cf. Carica	Galium cf. Yemense
Avena sp.	Echinochloa sp.	unknown	Linum usitatissiumum	Rumex sp.
	Paspalum sp.		Phoenix dactylifera	Brassica sp.
	Sporobolus sp.		Juniperus sp.	Plantago sp.
	Unknowns		Asteraceae	
			Convolvulaceae	

Table 2. Macrobotanical taxa from the al-Aḏla‘ settlement context after Lewis 2005, 287 table 8.4.

major cultivated grain crops	weeds	fruit, oil, fiber and pulses	Miscellaneous
Hordeum hulled barley	Agrostemma githago	Vitis vinifera	cf. Acacia
Hordeum	Alisma	Phoenix dactylifera	Conifer
Hordeum naked barley	Centaurea cyanus	Prunus dulcis	
Avena oats	Chenopodium	Camelina	
Triticum aestivum/durum	Convolvulus	Linum usitatissimum	
Triticum durum	Coronilla	Sesamum indicum	
Triticum hulled wheat	Echinochloa crusgalli	Brassica nigra	
Triticum monococcum	Galium	Fabaceae cultivated	
Secale cereale	Lolium temulentum	Lens culinaris	
Cerealia indet	Malva neclecta	Pisum sativum	
	Medicago lupulina		
	Melilotus		
	Plantago lanceolata		
	Poaceae indet.		
	Solanum nigrum		
	Solanum		
	Thalictrum		
	Thlaspi arvense		
	Trifoliae		

Table 3. Occurrence of excavated charred plant remains from Ẓafār 2006, after Rösch in Franke et al. 2008 supplement. The wood samples were identified by Thomas Ludemann, Freiburg University.

At both sites sieving and flotation were used to collect floral and faunal remains. At al-Aḏla‘ over 1000 litres of soil were flotated (cf. Table 2; Lewis 2005: 394). Barley, wheat, and oats dominate. But many other plants also were cultivated. The results of the fruit and seed analysis from Ẓafār Stone Building are presented in Table 3 (Franke et al. 2008: 221–223, Pl. 11, supplement). Totally, 4939 fruits and seeds are isolated from 317 litres of soil samples, what means average concentration of 59.5 items per litre. They represent at least 16 species of cultivated plants and several weeds. Roughly the features can be grouped in three clusters[7].

[7] Other sources are also available for the palaeoagriculture, especially almanacs compiled during the medieval Rasulid period (Varisco 1997) which contrast in the newly introduced fruit trees. Cf. Rösch in preparation.

The plants recovered in excavations correspond nicely to those mentioned in musnad texts: exceptions are the mention of tamarisk (salt cedar) and zizyphus (Christ

	NIF*	NIS%	WIF+	WIS%
Cattle, BOS	50	5.7	1275.5	26.2
Sheep, OVIS	24	2.7	2640	5.4
Goat, CAPRA	6	0.7	58	1.2
Sheep or goat OVIS/CAPRA	753	85.9	2076.3	42.7
Horse, CABALLUS	1	0.1	33	0.7
Donkey, ASINUS	2	0.2	22.4	0.5
camel, DROMEDARIUS	12	1.4	1105	22.7
dog, CANIS	10	1.1	10	0.2
Domesticates, total	858	97.8	4844.2	99.6
unident. Equid	1	0.1	1.7	0
wolf or dog	3	0.3	3.3	0.1
domestic or wild animals	4	0.5	5	0.1
Gazelle, Gazelle spec.	11	1.3	9.6	0.2
unident. Birds	4	0.5	5.3	0.1
wild animals total	15	1.7	14.9	0.3
identified animal remains total	877	100	4864.1	100
identified bones	877	77.5	4864.1	89.1
unidentified bones	255	22.5	593	10.9
animal remains total	1132	100	5457.1	100

* number of identified fragments
+ weight of identified fragments
Table 4. Osteal identifications from Ẓafār cemetery zc001, excavated in 2000, after Uerpmann 2007.

Identification	NISP	percent	percentage eliminating indeterminate	percentage eliminating indeterminate and body size	percentage identified to level of genus
Indeterminate	9030	71.25%			
Large mammal	140	1.10%	3.84%		
Equus	2	0.02%	0.27%	0.05%	0.17%
Bos	33	0.26%	0.91%	2.72%	4.42%
Medium mammal	1659	13.09%	45.54%		
Bovid	9	0.07%	0.19%	0.58%	
Ovis-capra-gazella	377	2.97%	10.35%	31.11%	
Ovis/capra	536	4.23%	14.71%	44.22%	71.85%
Ovis	100	0.79%	2.74%	8.25%	13.40%
Capra	47	0.37%	1.29%	3.88%	6.30%
Gazella	18	0.14%	0.49%	1.49%	2.41%
Sus	3	0.02%	0.08%	0.25%	0.40%
Carnivore	3	0.02%	0.08%	0.25%	
Small mammal	631	4.98%	17.32%		
Vulpes	1	0.01%	0.03%	0.08%	0.13%
Lepus	6	0.05%	0.16%	0.50%	0.80%
Rodent	42	0.33%	1.15%	3.47%	
Soricid	6	0.05%	0.16%	0.50%	
Cricitid	12	0.09%	0.33%	0.99%	
Murid	19	0.15%	0.52%	1.57%	
Total	12674		N=3643	N=1212	N=746

Table 5. Identified mammal bone from the al-Aḍlaʿ settlement context, after Lewis 2005, 283 table 8.3.

thorn) in addition to honey (dbs) which is not a plant but rather a cultivated product (Sima 2000: 242). Strangely, sorghum and oats are not identifiable, although the former is the dominant subsistence crop since medieval times (Varisco 1994: 165). To judge from the number of textual mentions, the southern highlands raised far fewer grapes than the northern highlands (ibid. 259).

Like flora, fauna is a topic in and of itself, but can be summarised here. Briefly, some animals are endemic but some came later. Although the prime minister of the Yemen once two giraffes had in his garden, there is no evidence for their natural occurrence in the Yemen (oral information D. Stanton 21.01.2010). To judge from other parts of Arabia, there is a high probability that certain animals existed early in the highlands, for example Rattus rattus und Sus scrofa. Rats have always parasitically accompanied human food production. These 'mammals of mass destruction' are invasive, proliferate amidst agriculture and food storage facilities, destroy the natural and anthropogenic habitat. Rat remains by themselves are considered evidence of human settlement (Tchernov 1984). Rat remains have been published from 2nd millennium Kalba in the Sharjah emirate (Mosseri-Marlio 2003) and from contemporary sites on the island of Baḥrayn as well (Uerpmann & Uerpmann 2005). The donkey was domesticated and belongs in the Ḥimyarite period, if not earlier.

Faunal remains from Ẓafār were excavated from the graves at al-Aṣabī, and seldom are mere surface finds (Table 4). Owing to the disturbances of these contexts, they cannot be narrowly dated, and one must assume most to be of Ḥimyarite date (calibrated ^{14}C determinations from grave zg07: 525–604 CE & 418–533 CE). The sampling procedure and qualitative differences between the identifications from the two sites (Table 5) preclude more than general characterisation. In the tombs neither sieving nor flotation took place. Compared to each other, the proportions of species from the two sites are unequal. The faunal remains belong to the grave goods and reflect the food eaten in the settlement.

There is no evidence which allow a distinction between a funerary meal as opposed to grave provisions or offerings. One certainly would expect rodents in a settlement, but far less so in a cemetery. Domesticates are more numerous and important than wild animals as a source of food. Sheep and goats seem the main non-human kind of bone in the tombs.

These results complement the occurrence of wild animals and domesticates in musnad texts (Sima 2000). The former include wild goat/deer, wild goat, flea, gazelle, ibex, lion, leopard, locust, onager (wild ass), oryx antilope, vulture. Some designations for domesticates are unclear and contain several non-specific words. Specifically mentioned domesticates include the bull, camels of various kinds, cattle, dog, donkey, goat, horse, lamb, mammal, mare, mule, ram, sheep. Several of these do not occur in the archaeologically identified samples.

Sus occurs at al-Aḏla‘ and appears in Table 5 with other wild animals. It still exists in Saudi Arabia and different species once inhabited most of the ancient world. Still other animals occur in musnad and Arabic texts, but are not represented in our osteal remains in Ẓafār: the ostrich, mule and onager, although ostrich eggs occur in the graves at Samad al-Shān in Oman. Marine molluscs occur commonly in the debris at Ẓafār in the highlands and have yet to be identified by species. Obviously they are exotic. According to Ibn Hishām, ‘Ā’isha, the reputed favourite wife of the Prophet Muḥammad, wore a shell necklace from Ẓafār – 90 km removed from its closest point of marine origin.

The Zebu was introduced very early, to judge from this motif in the visual arts. The dromedary was domesticated in the Iron Age and finds frequent mention in Ḥimyarite period texts. Horses appear to become common in the 2nd and 3rd centuries.

Degradation of the Environment

Despite the sustained geoarchaeological research of the Chicago Ḏamār team in the highlands, still lacking is a model for the erosion of Ẓafār – a heavily populated site in the highland region. Ueli Brunner (1999) visualised a graphic model for the highlands, which shows diachronically the deforestation and growth of settlements. Experts agree that with the terracing, building of dams, agriculture and habitation activities stress the environment, for example through deforestation. Experts would agree that the highlands were forested (Hepper and Wood 1979), but population pressure increased erosion of the fragile environment with a thin soil cover with little traction on steep (±20°) rocky slopes. Bronze Age farmers went to great effort to counter soil and moisture loss. What is lacking for the highlands is a more precise model of how the erosion progressed over time and its relation to the degrading of the landscape. At what point can one refer to advanced erosion? This would logically coincide with the heaviest population growth, the latter which diminished as the environment lost its productivity.

Today large slopes with no soil whatever (Yule 2007: 113 Fig. 8) amount to as much as 25% of the surface. Even if a part of this were once usable for agriculture, the Ḥimyarite population of Ẓafār cannot have been nourished solely from the immediate vicinity. Most of the cropland lay in the surrounding intermountain plains. Presumably a part of this deficit was filled from the Qāʿ al-Ḥaql, a mere 5 km to the west, which nowadays reportedly yields 50-60 tons of produce per year (pers. communication Y. ʿAbdullāh). Turning to a model for the environmental degradation of neighbouring Axum, it seems clear that the contemporary landscape is vastly inferior to that which provided a resource base for the rise of Ḥimyar (Butzer 1981: 476).

In order to reconstruct the climatic history, unfortunately, no relict vegetation has survived in the area. More specific data with regard to the ground cover at Ẓafār during the Ḥimyarite age can only be collected by means of on-site research. Laminated and datable samples which contain pollen are most likely to have survived in the aggraded wettest areas – at the Ẓafār/Maʾǧil al-Šaʿbānī reservoir and at the western end of the al-Šagog (stand. Arab. al-Šaqāq) dam in the Wadi al-Ḥaf. These are the best local candidates to reveal a floral and erosional local history. There is little evidence for the time being for habitation after the demise of the Stone Building shortly after 500 and Geʿez inscriptions postdate the Axum-Ḥimyarite war of 523–525 (pers. communication W. Müller and N. Nebes). But early Islamic pottery and other remains have been recorded in the Ḏamār project area (pers. communication K. Lewis 28.01.2010). For whatever reason, shortly following 525 the historical record breaks in the traditional capital (Yule in press). It would be desirable to seek evidence for accelerated soil displacement from 300–500 at Ẓafār. This might also have stretched into the Islamic period occupation, if there was one here.

Calamities in the Arḍ Ḥimyar?

A new dissertation contrasts the large number of towns in South Arabia of the 3rd century with the small number 200 years later (Schiettecatte 2006: 494, figs. 101D & E). These data correlate with other signs of decline be they cultural, military, financial, political or a combination of these (Yule in press).

The Byzantine world was bedevilled in the 6th century with an astonishing array of comets, earthquakes, eclipses, the dust veil event, fires, floods and locust plagues (Brandes 2005; Stathakopoulos, 2004). Their frequency increases in the 530s. In 535, the year without a summer is believed to result from a veiling of the sky as a result of an enormous volcanic explosion of Krakatoa in South-east Asia (Keyes 2002). But the worst catastrophe was yet to await the East Romans. In his polemical writings Procopios is the most detailed witness to a disaster which took place from 541 to 543 – the world's first pandemic. Its sources are well-articulated (Meier 2005, 91). A pandemic (from Greek πᾶν pan "all" + δῆμος demos"people") is a super epidemic of infectious disease that spreads through human populations across a large region; for instance a continent, or even worldwide.

In detail, Procopius (History of the Wars) describes the symptoms and their development and its chronology in the capital. Six years after this volcanic winter a plague breaks out first in Pelusium near the Nile delta and then moved to Arabia, Constantinople and the entire Near East including Anatolia – the first certain pandemic of bubonic plague in history. Plague has two meanings: any major epidemic and a specific illness caused by the Yersinia pestis. That of 541–3 is still referred to as the 'Justinian Plague'.

O. Bendedictow (2004: 39) suggests that the Justinian pandemic even began in South Arabia which he describes as having a “plague focus” just north of Ṣan‘ā’. He emphasises the transmission potential of the caravan trade with Ethiopia at this time which explains the spread of other plagues. One simply assumes that the black rat host has always followed its human host. Finds of rats are known from early contexts in al-Aḍla‘ (Table 5), Kalba (U.A.E., Mosseri-Marlio 2003), Qalā‘at al-Baḥrayn, and Sa’r al-Ǧisr, on that same island (Uerpmann/Uerpmann 1997, 2005) – but not yet in Ẓafār. Only two epidemics find mention in musnad texts: one of the 2nd century (Robin 1992: MAFRAY-al-Ḥijla 1) and a second in 657 Him=June 548 in CIH 541 (Abraha’s great Res gestae stela). In point of time the latter does not correlate with the 'Justinian Plague', unless one assumes a dating of 115 B.CE for the beginning of the Ḥimyarite calendar instead of 110. With all of these documented calamities, it is strange that only two plagues find mention in Ḥimyarite texts, for this area must have shared the fate as the rest of the region.

That South Arabia is plagued by another problem – tectonic activity, is well-documented (Table 6), for example by the great event of 1982 in nearby Ḏamār which resulted in the death of 3000 inhabitants. Certainly even the worst disasters did not always find their way into written form and seldom survive in musnad texts. There is not even a word for earthquake in Sabaic. Future work can consider in greater detail the reasons for the manifest decline in the number of towns and their size in the 6th century. A constellation of environmental degradation and plagues coupled with political and military factors including internal strife merit discussion.

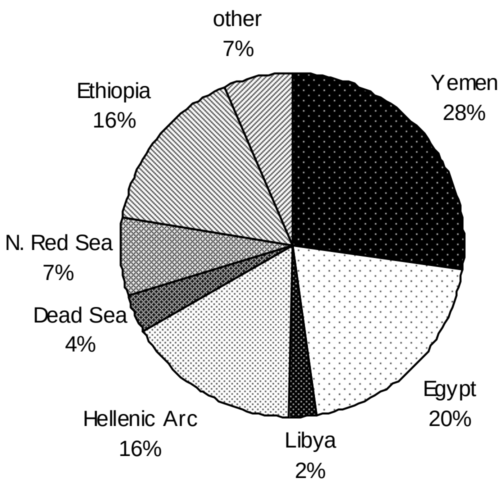

Table 6. Earthquakes prior to 1900, after Ambrayses et al. 1994 fig. 4.2.

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3. Ẓafār/Ma'ǧil al-Šaʿbānī reservoir.
4. So-called hockey stick plot which shows nine climatic reconstructions and four simulations.
5. Pottery mostly from the Stone Building: 01 necked jar 08~172.002, 02 bowl 03~039.06, 03 cooking pot 08~180.013, 04 jar 07~158.014, 05 open bowl 03~018.01, 06 combed 07~036.15, 07 rim profiled 09~160.009, 08 rim carinated 03~019.02, 09 terra sigillata 04~003, 10 bowl 09~454.002, 11 bowl 07~140.25, 12 storage vessel 08~262.001, 13 plate/lid 03~028.44, 14 spout 07~050.32, 15 grip 07~036.34, 16 rim profiled 07~054.06, 17 stand ring 07~140.11, 18 lug 03~011.06, 19 lid-seated neck 03~028.24, 20 handle 08~151.005, 21 amphora zm997, 22 amphora zm920.

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Figure credits:
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Fig. 2. Jac A.M. Gun, van der/ʿAbdūl Aziz Aḥmed, The Water Resources of Yemen. A Summary and Digest of Available Information (Sana'a, Delft 1995) (=Water Resources Assessment Yemen, Report 35).
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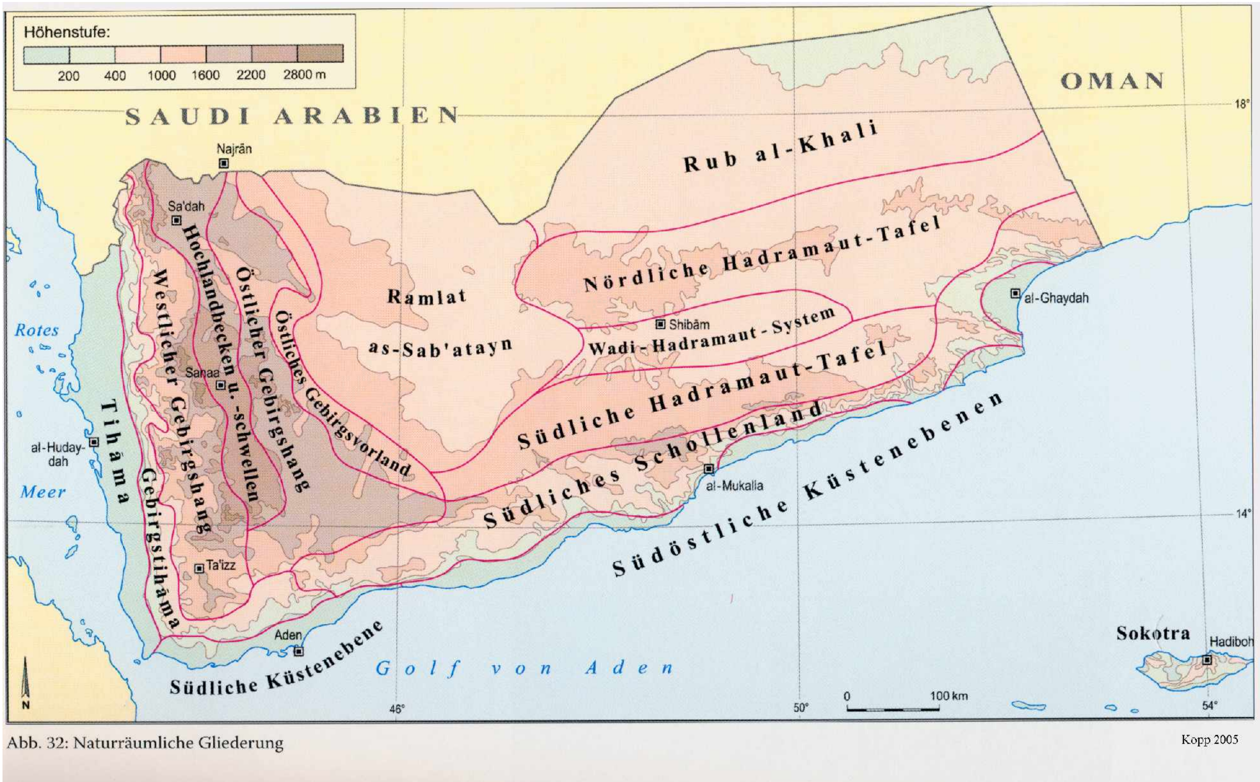

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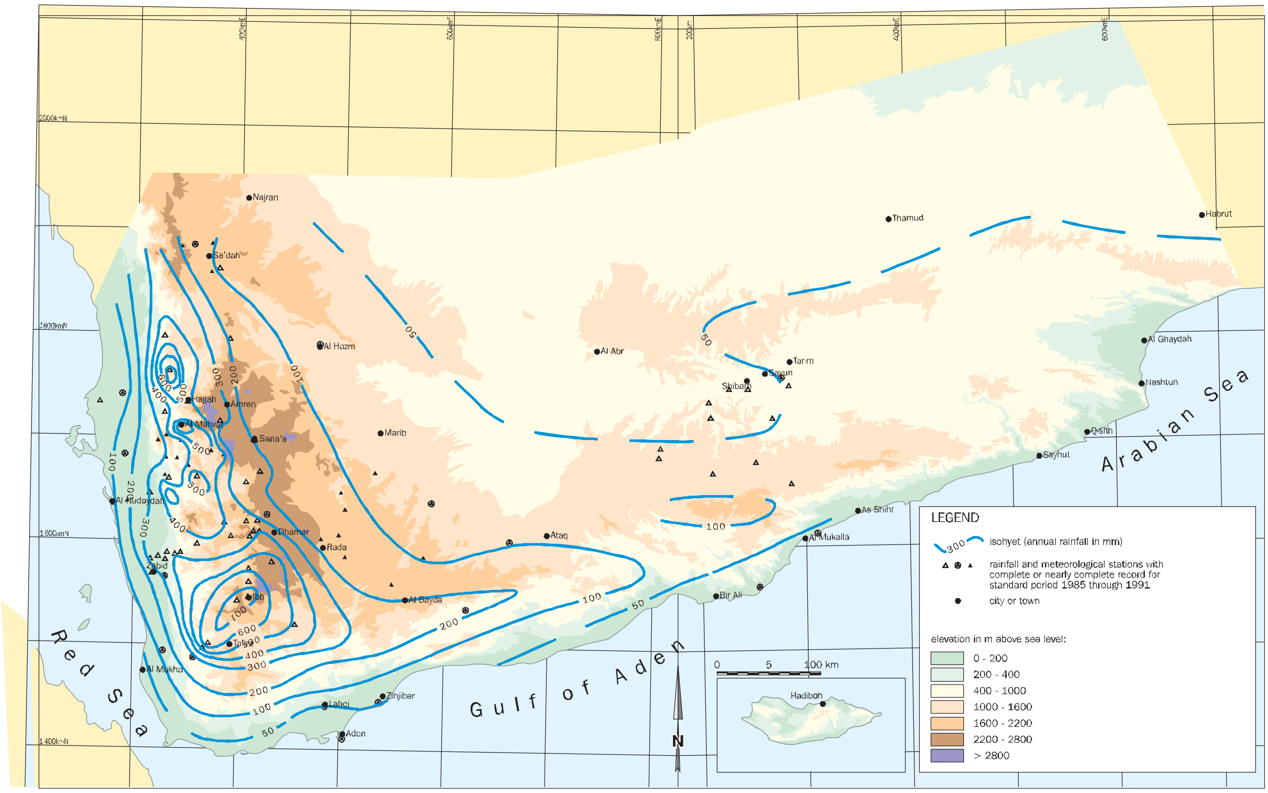
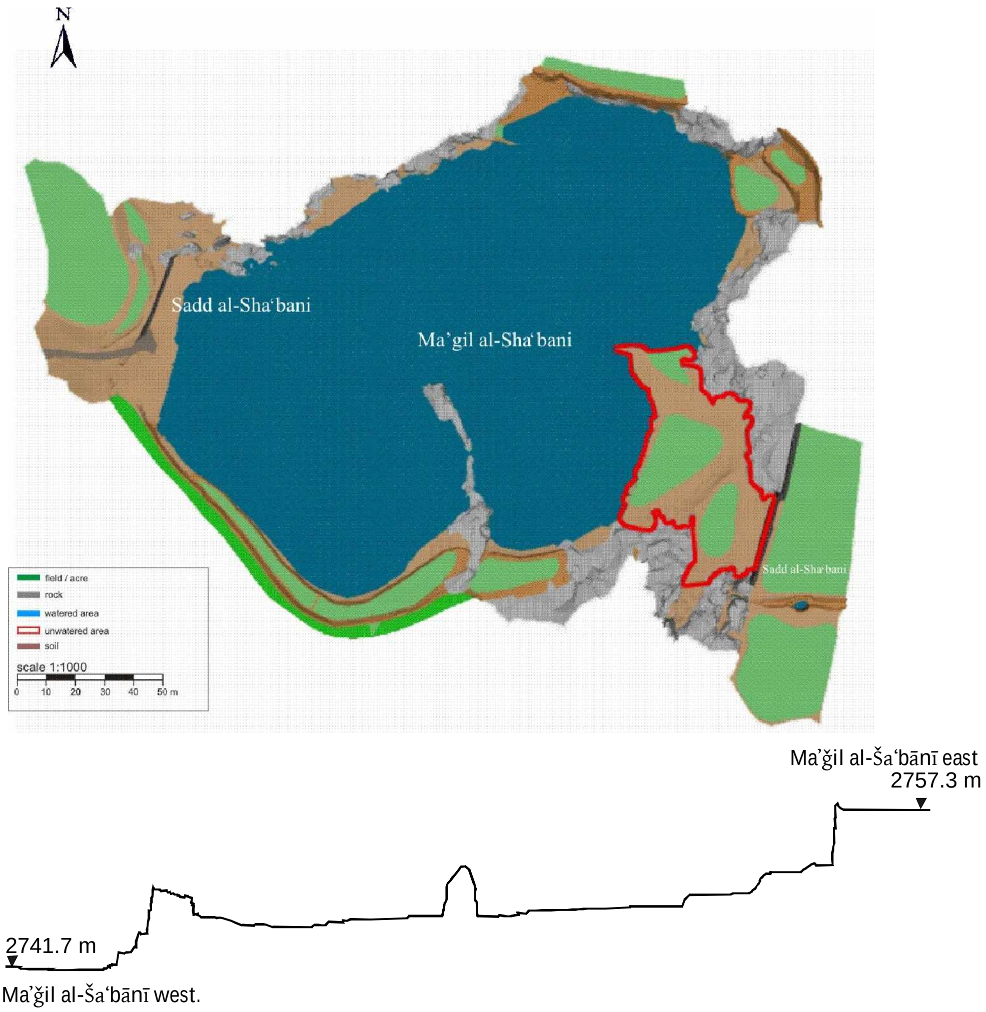


Fig. 2. Annual precipitation in South Arabia.



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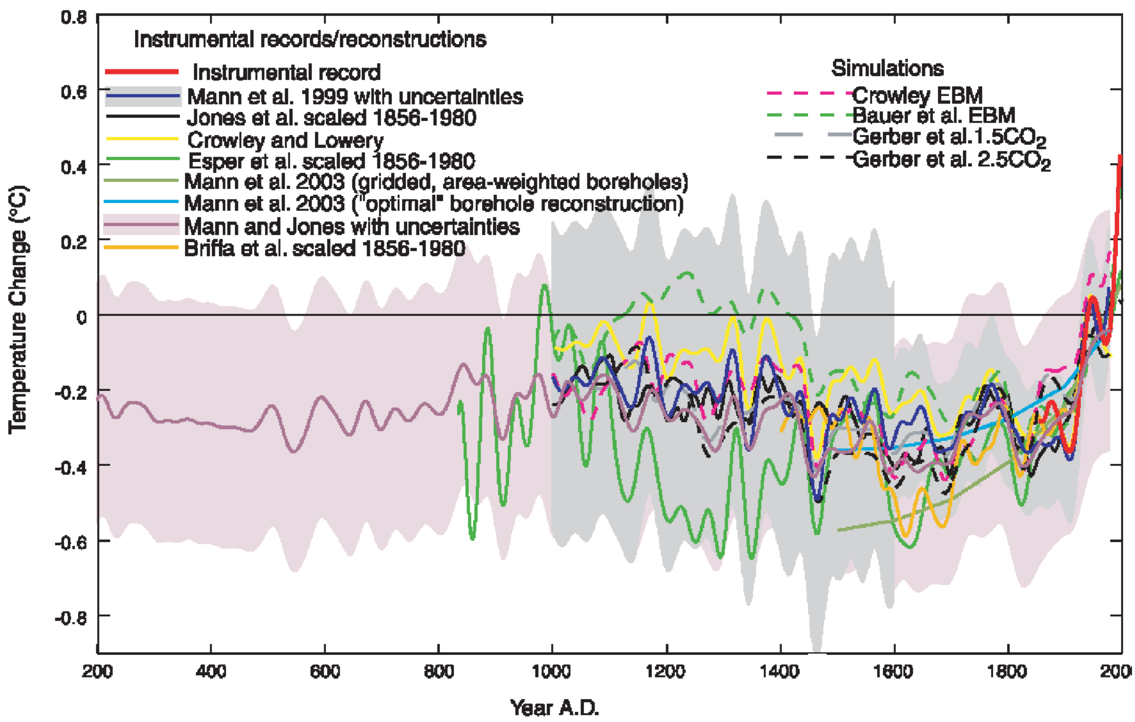

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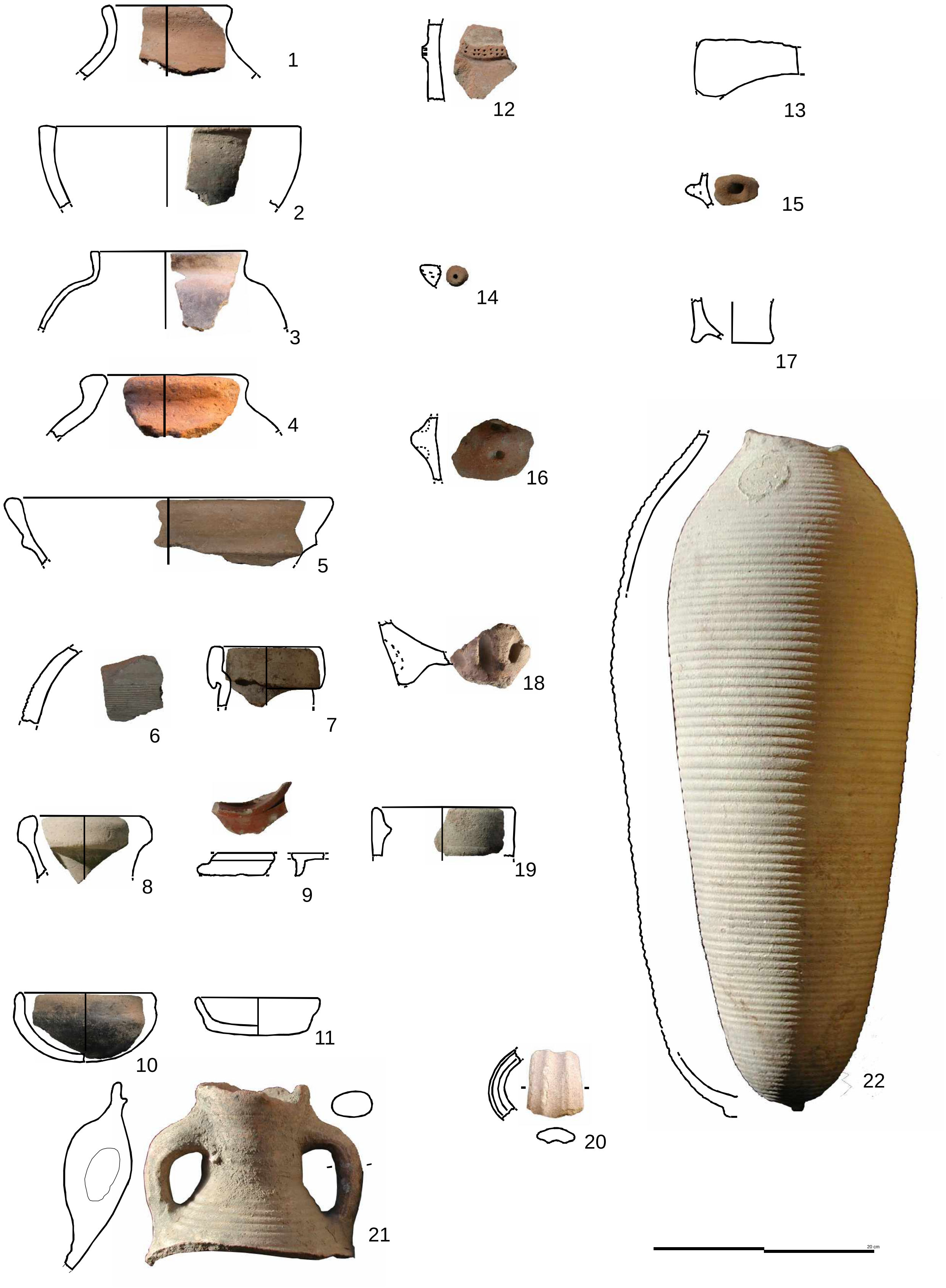

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