

Table 1 Basic information concerning samples analyze

Data bank number	Ref number	Excavation campaign	Excavation unit	Sample reference	Petroleum analyses	Frankincense analyses	Macroscopic description	Location	Date	Comment
961	1						present-day frankincense. pale yellow and yellow resin, some orange grains	souk of Sana'a		pure frankincense
962	2						black sample, hard with vacuolar texture. Burned?	central sanctuary P59	end of AD 1st century to beginning of AD 5th century	on a table for frankincense
963	3						numerous black debris with vacuolar texture. Burned?	central sanctuary P59	end of AD 1st century to beginning of AD 5th century	at the foot of the temple staircase
964	4						white powder	central sanctuary P59	end of AD 1st century to beginning of AD 5th century	on a table for frankincense
1257	5	QAN.95	UF28	e.77			yellow powder with centimetric clusters		end of AD 1st century to beginning of AD 5th century	outside P51 (habitat or administration of priests)
1258	6	QAN.95	UF35	e.118			yellow powder without any scent	central sanctuary P59	end of AD 1st century to beginning of AD 5th century	occupation level
1259	7	QAN.95	UF.6	e.18			yellow powder without marked scent.some orange grains	central sanctuary P59	end of AD 1st century to beginning of AD 5th century	surface
1260	8	QAN.95	UF15	e.93			black powder.Gray-brown mixture with vacuolar structures and some well-preserved grains. Partly burned?	central sanctuary P59	end of AD 1st century to beginning of AD 5th century	occupation level

1261	9	QAN.95	UF31	e.104	brown mass with mineral elements and vacuolar structures. Burned?	central sanctuary P59	end of AD 1st century to beginning of AD 5th century	occupation level, frankincense collected at the NE angle of the stair, on an incense burner
1262	10	QAN.95	UF15	e.95	brown mass, heterogenous, carbonised, vacuolar structures	central sanctuary P59	end of AD 1st century to beginning of AD 5th century	occupation level, ashes on a burned sanstone plate
1263	11	QAN.95	UF31	e.103	black powder, glossy, highly carbonised?	central sanctuary P59	end of AD 1st century to beginning of AD 5th century	occupation level
1264	12	QAN.95	UF31	e.120	brown mass with vacuolar structures. Carbonised? Some sea shel land minerals trapped in the lump	central sanctuary P59	end of AD 1st century to beginning of AD 5th century	occupation level
1265	13	QAN.95	UF26	e.105	brown mass inside a potsherd. Vacuolar structures of degasing but no evidence of burning	central sanctuary P59	end of AD 1st century to beginning of AD 5th century	occupation level, potsherd
1266	14	QAN.95	UF17	e.65	white powder agglomerated in 0.5 cm balls	central sanctuary P59	end of AD 1st century to beginning of AD 5th century	occupation level
1267	15	QAN.95	UF29	e.98	white powder	central sanctuary P59	end of AD 1st century to beginning of AD 5th century	occupation level
1268	16	QAN.95	UF5	e.34	1268a- yellow-reddish resin. 1268b-white-yellow powder		end of AD 1st century to beginning of AD 5th century	surface
1269	17	QAN.96	UF38	e.139	pure solid bitumen with chonchoidal structure	In hearths, at the beginning of the pathway leading to the sanctuary P59	end of AD 1st century to beginning of AD 5th century	

1270	18	QAN.96	UF39	e.183	yellow to orange grains-resin with a balsamic scent	in the destruction of altars (?) P107 and P92	end of AD 1st century to beginning of AD 5th century
1271	19	QAN.96	UF59	e.220	pale yellow to white powder , red-orange grains	occupation of P10	end of AD 1st century to beginning of AD 5th century
1272	20	QAN.96	UF46	e.169	orange to red grains	in the destruction of altars (?) P107 and P92	end of AD 1st century to beginning of AD 5th century
1273	21	QAN.96	UF40	e.148	gray powder: ashes?	outdoor space, north of the hall of columns	end of AD 1st century to beginning of AD 5th century
1274	22	QAN.96	UF51	e.206	yellow powder	in hearths, established in the whole outdoor space, at South-West of the enclosed space	end of AD 1st century to beginning of AD 5th century
1275	23	QAN.96	UF40	e.146	1275a- brown-black lumps. Burned? 1275b black powder, glossy with some sea shells, sometime broken	outdoor space, north of the hall of columns	end of AD 1st century to beginning of AD 5th century
1276	24	QAN.96	UF40	e.144	yellow powder	outdoor space, north of the hall of columns	end of AD 1st century to beginning of AD 5th century
1277	25	QAN.96	UF58	e.196	black-brown lumps of several cm, hard and heavy	surface	end of AD 1st century to beginning of AD 5th century

1278	26	QAN.96	UF55	e.194	some yellow grains	hall of columns P9, on the upper ground	end of AD 1st century to beginning of AD 5th century
1279	27	QAN.96	UF46	e.192	brown mass with vacuolar structures but not carbonised inside a potsherd. Abundant degassing.	in the destruction of altars (?) P107 and P92 at NE	end of AD 1st century to beginning of AD 5th century
1280	28	QAN.96	UF58	e.204	white powder in small grains, homogenous and pure	surface	end of AD 1st century to beginning of AD 5th century
1281	29	QAN.96	UF64	e.240	brown mass with a carbonised aspect but likely amixture of bitumen and minerals	on the ground of the pillared hall P9	end of AD 1st century to beginning of AD 5th century
1282	30	QAN.96	UF56	e.188	Brown to black mass with vacuolar aspect . Burned?	Hall of columns P9, on the upper ground	end of AD 1st century to beginning of AD 5th century
1283	31	QAN.96	UF52	e.159	yellow to brown resin	outdoor space, north of the hall of columns	end of AD 1st century to beginning of AD 5th century
1284	32	QAN.96	UF48	e.164	1284a- yellow powder mixed with black powder (burned?).1284b-Black mass (burned?)	in the destruction of altars (?) P107 and P92	end of AD 1st century to beginning of AD 5th century
1285	33	QAN.96	UF51	e.205		in hearths, established in the whole outdoor space, at South-West of the enclosed space	end of AD 1st century to beginning of AD 5th century

1286	34	QAN.96	secteur VI		large plate 3-4 cm long and 1 cm thick. White and red-orange grains agglutinated in all directions- pure frankincense?	sector VI. Burned warehouse excavated by A.V.Sedov	AD 150-200 or AD 225	
1287	35	QAN.96	UF36	e.140	1287a-white powder with mineral grains and black grains (burned resin?). 1287b-brown-black mass with vacuolar structures	surface and occupation	end of AD 1st century to beginning of AD 5th century	At the foot of altars, bordering the driveway leading to the sanctuary P59
1288	36	QAN.96	UF58	e.207	red-orange resin	surface	end of AD 1st century to beginning of AD 5th century	
1289	37	QAN.96	UF75	e.239	1289a- carbonised wood? 1289b brown mass with vacuolar structures (burned?)	remblais de P.10-reconstruction	end of AD 1st century to beginning of AD 5th century	
1290	38	QAN.96	UF58	e.210	black lumps , fairly hard with few vacuoles	surface	end of AD 1st century to beginning of AD 5th century	
1291	39	QAN.96	UF36	e.143	powder with big lump of yellow to orange resin.	surface et occupation	end of AD 1st century to beginning of AD 5th century	At the foot of altars, bordering the driveway leading to the sanctuary P59
1292	40	QAN.96?	secteur VI		brown mass with vacuolar structures: black glossy powder	sector VI. Burned warehouse excavated by A.V.Sedov	AD 150-200 or AD 225	
1293	41	QAN.95	UF5	e.28	fragrant substance encountered in balms of Egyptian mummies	surface	end of AD 1st century to beginning of AD 5th century	

Table 2 Rock-Eval data of samples analyzed. Significance of abbreviations: S1 (mg HC/g sample), S2 (mg HC/g sample), S3 (mg CO₂/g sample), TOC (Total Organic Carbon in %/sample), IP = S1/S1 + S2, OI =Oxygen Index (mg CO₂ / g of TOC), HI = hydrogen index (mg HC/g of TOC).

Insoluble residue after extraction with dichloromethane													Rock-Eval data on residue			Whole sample			Comments							
Sa mpl e nu mb er	Sa mpl e nu mb er	T O C	quartz (%)	calcite (%)	dolomite (%)	halite (%)	aragonite (%)	gypsum (%)	anhydrite (%)	plagioclases (%)	feldspaths K (%)	pyrite (%)	clays & mica (%)	I.O.C. (%)	I.R.H. (%)	I.R.H. (%)	I.O.C. (%)	H.I. (%)		O.I. (%)	Tmax	calcite	sulfate	halite		
1258	6	61.8																							x	tellow powder without any smell
1259	7	57.2																								yellow powder with a slight aromatic smell
1261	9	25.5	9	42	3	6	traces	0	0	5	0	0	31	3.45	93.3	48.8	3.43	77	80	432						powder with white grains (minerals ?) + burned frankincense
1263	11	36.3																						x	x	black shiny powder
1264	12	30																						x		brown mass , some shells in

126 5	13	6. 5	7	65	3	5	3	0	0	1	0	0.2	13	2.5 9	94 .1	2 4. 1	2.69	2 0 5	60	43 3				the mixture
126 6	14	3. 56																				x	brown mass with vacuolar figures, some shells	
127 9	27	18	9	43	5	5	0	4	0	4	0	0.4	26	3.2	89 .1	4 3. 2	1.31	1 9 8	86	43 3				white powder brown mass which does not seem to be carbonize d
128 0	28	0. 09																			xx x	gyp su m	x	white powder. TOC = 0.09%/sa mple
128 1	29	17 .8	3	73	4	6	0	0	0	1	0	0.2	11	1.2 8	92 .5	1 6. 8	3.55	2 6 6	52	43 0				mass with a carbonize d aspect
128 3	31	9. 3																				x	yellow to brown resin- TOC = 9.3 %/sample	
128 6	34	37	28	25	4	25	3	4	3	2	trac e s	0	5	0.5 4	67 .4	3 5. 9	0.32	# # #	12 34 0	43 0				big plate
128 7	35	11 .2																				x	x	white powder

129 41 0. oui
3 18

xx gyp
x su
m
white
crystals -
gypsum
and
calcite -
TOC =
0.18%

Table 3 Mineral composition of some samples

Well	Geomar k or lab number	lat t	long g	depth h (in feet)	age	C1 5+ sa t	C1 5+ ar o	d1 3C as p	d1 3C re s	d D as p	pris t/p hyt	C30 hop ane (pp m)	% C 7	% C 8	% C 9	Ts /T m	C2 9Ts /T m	Ol ea n/ H	GA /C 31 R	Rea rr/ Reg	Ste r/T erp	C 2 9/ H	S1 /S 15 T	2 9 T s	com ment
Sunah 2	XYN000 1	15 .7 74	49 .0 49	9039	U.Jur assic shale s	- 29	- 27. 6				1.8	403	3 3. 5	2 7. 7	3 8. 8	1. 5 9	0.8 9	0	0.1 2	3.0 9	0.4 6	0. 3 6	3. 02	2 9 T s	abun dant diast eranes
Ayad	YN0001	14 .9 45	46 .8 65	3125	M.Jur assic	- 28 .5	- 27				1.4 6	289	3 8. 4	2 6. 7	3 4. 9	2. 0 1	0.6 3	0.0 1	0.0 4	3.4 2	0.5 2	0. 3 5	3. 96	2 9 T s	abun dant diast eranes
Alif	YN0002	15 .5 63	45 .8 03	5700	Turon ian	- 28 .2	- 26. 1				1.5 5	761	3 7. 3	2 5. 5	3 7. 2	1. 5 4	0.3 9	0	0.6 4	0.6 6	0.6	0. 4	0. 84	2 9 T s	abun dant diast eranes
Azal 1	YN0005	15 .5 84	45 .8 5	6900	Titho nian	- 28 .2	- 26. 3				1.5 8	868	3 5. 1	2 6. 5	3 8. 4	1. 1 2	0.3 2	0.0 2	0.6 3	0.6	0.6 9	0. 4 3	0. 77	2 9 T s	diast eranes

Camaa l4	YN0014	15 .6 54	49 .0 53	5614 - 5650	Barre mian	- 29 .5	- 28. 3		0.9 1	385	3 4. 7	2 4. 6	4 0. 7	1. 5 6	0.5 7	0.0 1	0.0 8	3.7 3	0.7 4	0. 59	3. 6	diast eran es	
Hahma de seep	YN0016	16 .2	48 .1	surfa ce		- 29 .4	- 28. 21		1.2 6	8	6. 3	8 3.	1 0. 7	5. 1	1.0 1	0.5	5.2 3	0.3 6		0. 7	0. 1	???	
Shabwa salt mine 1	YN0017			surfa ce	Uppe r jurass ic	- 30 .	- 29. 3	- 27. 9	- 28 .7		0.2 6	533	1 3. 7	2 8. 2	5 8. 1	0. 3	0. 2	0.5 2	0.1 2	0.8 3	0. 4	0. 03	no diast eran es
Shabwa salt mine 2	YN0018			surfa ce	Uppe r Jurass ic	- 29 .3	- 27. 7	- 25. 8	- 28 .1		126 7	3 7.	1 8. 9	4 3. 7	0. 1	0.0 7	0	0.9 9	0.0 3	0.5 2	0. 7	0. 02	no diast eran es
Mousabah 1	YN0019	15 .3 01	45 .9 61	1209 0		- 28 .2	- 26. 2		1.6 8	69	3 6. 1	2 5. 9	3 7. 9	2. 1 6	0.5 1	0.0 1	0.6 5	1.2 8	0.4 5	0. 3	1. 5		
Mousabah 1	YN0020	15 .3 01	45 .9 61	1243 4		- 28 .2	- 26. 3		1.6 5	76	3 6. 4	2 4. 9	3 8. 7	2. 2 2	0.5 2	0.0 13	0.6 1			0. 3	1. 3		
Qâni'	1265			surfa ce		- 26. 5	- 8 5		1.0 2		1 4. 3	3 1. 2	5 4. 5	0. 2 6	0.1 6	0	0.4 4		0.2 3		0	no diast eran es	
Qâni'	1269			surfa ce		- 25. 7	- 8 1		0.2 4		2 7	3 1. 3	4 1. 7	0. 7 3	0.2 2	0.0 7	0.1 5		0.5 6		0. 58	diast eran es	
Qâni'	1279			surfa ce		- 27. 1	- 7 0		0.3 4		2 0.	3 5. 9	4 3. 5	0. 3 4	0.1 7	0.0 8	1.0 9		0.4 5		0	no diast eran	

Qâni'	1281	surfa ce	- 27. 5	- 6 9	0.7 5	2 7. 1	2 4	4 9	0. 1 5	0.1 4	0.0 5	0.5 5	0.2 4	0	es no diast eran es
A'Rum ah- Balhaf	1393	surfa ce	- 26. 3	- 8 6	1.1 5				1. 6 1	2.1	0	6	2.1 3		no diast eran es- tricy clic terpa nes- extre mely degr aded
Harub ya- Balhaf	1394	surfa ce	- 24. 9	- 7 6					1. 1	1.5		8.1	0.7 7		no diast eran es- extre mely degr aded
Minqa h	1332	surfa ce	- 26. 4						0. 5 5						no stera nes and terpa nes -

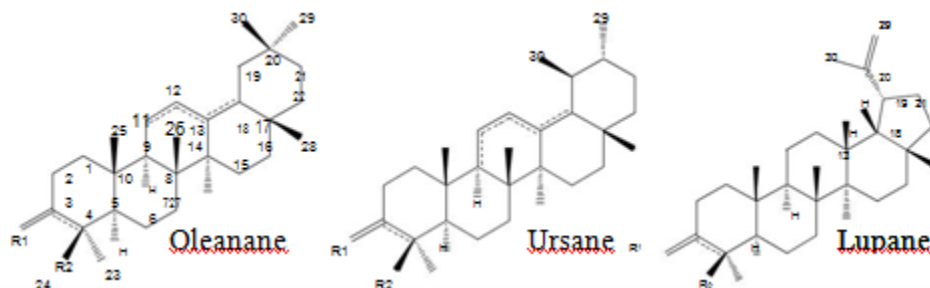
Table 4 Molecular composition on crude oils, oil seeps and some bitumen from Qâni

Sam ple num ber	Location	TOC (%)	EO (%)	sat. (%)	aro. (%)	pol. (%)	sat. (%)	aro. (%)	res.(%)	asp.(%)	d13 Casp (‰ /VP DB)	dDas p (‰ / SM OW)	d13 Csat (‰ /VP DB)	d13 Caro (‰ /VP B)	d13Cr es.(‰ / VPDB)	d13Cex tract (‰ / VPDB)	dDext ract (‰ / SMO W)
961	Qâni'	67.6	95.2	0.8	17.3	81.9	0.7	21.6	75.3	2.4	-26.7						
962	Qâni'	31.1	9.7	1.8	10.6	87.6	1.2	14.9	39.3	44.6	-24.8						
963	Qâni'	22.2	29.9	0.7	6.4	92.8	0	10	39.8	50.2	-25.5						
964	Qâni'	7.6	11.1	0.02	2.9	97.0	0.1	2.3	52.5	45.1	-26.9						
1261	Qâni'	25.5	30.2	0.3	8.98	90.7	1.6	9.2	30.4	58.8	-25.6						
1265	Qâni'	6.5	14.7	4.4	4.8	90.8	1.7	2.2	15.2	80.9	-26.5						
1269	Qâni'	72.8	46.5	30.8	27.1	42	25.2	24.9	30.2	19.7	-25.7						
1271	Qâni'	49.1	99.9	0.01	16.0	83.9	0.3	6	54.5	39.2	-25.9						
1279	Qâni'	18	28.6	2.5	4.3	93.2	2.9	4.3	18.8	74	-27.1						
1280	Qâni'	0.09															
1281	Qâni'	17.8	23.4	1.8	5.6	92.5	0.6	2.5	14.8	82.1	-27.5						
1286	Qâni'		73.7	0.01	4.49	95.5	0.4	5.4	49.4	44.8	-25.2						
1393	Balhaf 1985- A'Rumah	basement ? Infra- cambrian?		13.3	22.3	64.4	13.3	22.3	35.7	28.7	-26.3						
1393	Balhaf 1985- A'Rumah	basement ? Infra- cambrian?		16	28.3	44.3	16	28.3	28.4	27.3			-28.2			-27.2	-112
1394	Balhaf 1985- Wadi Arubya	Mukalla sanstone-Lower Cretaceous		9.3	9.2	81.6	9.3	9.2	14.4	67.1	-24.9						
1394	Balhaf 1985- Wadi Arubya	Mukalla sanstone-Lower Cretaceous		9.4	7	16.4	9.4	7	12.7	70.9			-27.7			-25.6	-93
1332	near Mintaq 1	oil-stained sand-Tertiary	6.9	11.2	23.3	58.7	11.2	23.3	46.9	18.6	-26.4						
1822	Shabwa salt mine 1	Upper Jurassic	18.7	20	13.1	33.1	20	13.1	13.8	53.1	-27.9		-30	-29	-28.7		

1823	Shabwa salt mine 2	Upper Jurassic	14	11.2	1.7	12.9	11.2	1.7	8.9	78.2	-25.8	-29.3	-27.7	-28.1
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Table 5 Gross composition and isotopic data on samples from Qâni' and oil seeps

Skeleton type



No	Compound	tR (min)	Skeleton type	R1	R2	Double bond(s)
1	oleana-11,13(18)-diene	37.72	O	H	CH ₃	C11-C12 and C13-C18
2	ursa-11,13(18)-diene	37.92	U	H	CH ₃	C11-C12 and C13-C18
3	24-noroleana-3,12-diene	38.12	O	H		C3-C4 and C12-C13
4	olean-12-ene	38.31	O	H	CH ₃	C12-C13
5	24-norursa-3,12-diene	39.12	U	H		C3-C4
6	24-norlupan-3,20(29)-diene	39.32	L	H		C3-C4 and C20-C29
7	urs-12-ene	39.57	U	H	CH ₃	C12-C13
8	3-epi-β-amyrine	41.49	O	a-OH, b-H	CH ₃	C12-C13
9	3-epi-α-amyrine	41.94	U	a-OH, b-H	CH ₃	C12-C13
10	3-epi-lupeol	42.07	L	a-OTMS, b-H	CH ₃	C20-C29
11	ursa-9(11),12-dien-3-one	42.91	U	O	CH ₃	C9-C11 and C12-C13
12	β-amyrone	43.54	O	O	CH ₃	C12-C13
13	β-amyrin	44.06	O	a-H, b-OH	CH ₃	C12-C13
14	α-amyrone	44.4	U	O	CH ₃	C12-C13
15	α-amyrin	44.61	U	a-H, b-OH	CH ₃	C12-C13
16	lupenone	44.66	L	O	CH ₃	C20-C29

17	lupeol	44.95	L	a-H, b-OH	CO ₂ H	C20-C29
18	α -boswellic acid	45.15	O	a-OH, b-H	CO ₂ H	C12-C13
19	β -boswellic acid	45.63	U	a-OH, b-H	CO ₂ H	C12-C13
20	lupeolic acid	45.75	L	a-OH, b-H	CO ₂ H	C20-C29
21	O-acetyl α -boswellic acid	48.55	O	a-OAc, b-H	CO ₂ H	C12-C13
22	O-acetyl β -boswellic acid	49.17	U	a-OAc, b-H	CO ₂ H	C12-C13
23	O-acetyl lupeolic acid	49.28	L	a-OAc, b-H	CO ₂ H	C20-C29

Table 6 Triterpenoid compounds in archeological samples

Archaeological samples														
No	Compound	962	963	964	1286	1270	1277	1292	1258	1259	1263	1264	1287	1283
1	oleana-11,13(18)-diene	√	√	-	-	-	√	√	-	-	√	√	√	-
2	ursa-11,13(18)-diene	√	√	-	-	tr	√	√	-	-	√	√	√	-
3	24-noroleana-3,12-diene	√	√	√	-	tr	√	√	√	√	√	√	√	-
4	olean-12-ene	√	√	-	-	√	√	√	-	tr	√	√	√	-
5	24-norursa-3,12-diene	√	√	√	-	√	√	√	√	√	√	√	√	-
6	24-norlupan-3,20(29)-diene	√	√	-	-	√	√	√	-	-	-	-	-	-
7	urs-12-ene	√	√	√	-	-	-	tr	-	tr	√	√	tr	-
8	3-epi- β -amyrine	√	√	√	√	√	√	√	√	√	√	√	√	√
9	3-epi- α -amyrine	√	√	√	√	√	√	√	√	√	√	√	√	√
10	3-epi-lupeol	√	√	√	√	√	√	√	√	√	√	√	√	√
11	ursa-9(11),12-dien-3-one	√	√	√	√	√	√	√	√	√	√	√	√	√
12	β -amyrone	√	√	√	√	√	√	√	√	tr	tr	√	√	√
13	β -amyrin	√	tr	√	√	√	√	√	√	√	-	√	√	√
14	α -amyrone	√	√	√	√	√	√	√	√	√	√	√	√	√
15	α -amyrin	√	√	√	√	√	√	√	√	√	tr		√	√
16	lupenone	√	√	tr	tr	√	√	√	-	-	tr	-	-	-
17	lupeol	√	√	√	√	√	√	√	√	tr	-	√	√	√

18	α -boswellic acid	-	-	√	√	√	√	tr	√	√	-	√	√	√
19	β -boswellic acid	-	-	√	√	√	-	-	√	√	-	√	√	√
20	lupeolic acid	-	-	√	√	√	tr	-	√	√	-	√	√	√
21	O-acetyl α -boswellic acid	-	-	tr	-	√	-	-	√	√	-	-	tr	√
22	O-acetyl β -boswellic acid	-	-	tr	-	√	-	-	√	√	-	-	tr	√
23	O-acetyl lupeolic acid	-	-	tr	-	√	-	-	√	√	-	-	tr	√
