

SUPPLEMENTARY INFORMATION

Supplementary Materials and Methods

Study area and sampling

The Kalash are an enigmatic community living in the Chitral District in Khyber Pakhtunkhwa Province of present-day northern Pakistan. They are a non-Muslim minority and reside in three nearby villages known as the Kalash valleys (Bumburet, Rumbur, and Birir) (E71–40° longitude and N35–40° latitude). Samples from nine maternally unrelated Kalash individuals (Supplementary Figure S2), as well as 11 samples from neighboring populations (one Pashtun and 10 Kho samples) were obtained, as shown in the Supplementary Material as part of our unpublished work. This study was approved by the Ethics Committee at Kunming Institute of Zoology, Chinese Academy of Sciences, China. All procedures were handled in accordance with the Declaration of Helsinki, with informed consent obtained from each participant of the study.

Data analysis

Phylogeographic trees of mitogenomes were reconstructed manually and reconfirmed through mt-Phyl software (<https://sites.google.com/site/mtphyl/home>). Variants in the mitogenome sequences were scored relative to the revised Cambridge Reference Sequence (rCRS) (Andrews et al., 1999). The variable lengths in homopolymeric C-stretches in regions 303–315 and AC indels at 515–522, 16 182C, 16 183C, 16 193.1C(C), and 16 519 were disregarded in all phylogenetic reconstructions. The type of each variant was checked by mtDNA-GeneSyn software (Pereira et al., 2009). To estimate coalescent age using rho (ρ) and standard error sigma (σ) statistics (Forster et al., 1996; Saillard et al., 2000), a complete mitogenome rate (Soares et al., 2009) was adopted. New sub-haplogroups were named following the criteria of PhyloTree Build 17 (<http://phylotree.org/>) (van Oven & Kayser, 2009). A reduced median network was constructed based on complete mitogenomes using NETWORK 5.0 (www.fluxus-engineering.com/sharenet.htm) (Bandelt et al., 1999).

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Supplementary Tables

Supplementary Table S1 Whole mitogenome sequence data from previous literature and our new unpublished data included in present study

Nation	Geographic Region	<i>n</i>	References
Adygei	Eastern European & Siberia	17	HGDP (Zheng et al., 2014)
Armenian	Middle East & Caucasus	30	Schönberg et al., 2011
Azeri	Middle East & Caucasus	30	Schönberg et al., 2011
Balochi	South Asian	25	HGDP (Zheng et al., 2014)
Basque	European	20	Batini et al., 2017
Bavarian	European	20	Batini et al., 2017
Bedouin	Middle East & Caucasus	48	HGDP (Zheng et al., 2014)
Bengali	South Asian	86	Sudmant et al., 2015
Brahui	South Asian	25	HGDP (Zheng et al., 2014)
British	European	91	Sudmant et al., 2015
Burusho	South Asian	24	HGDP (Zheng et al., 2014)
Cambodians	East/South East Asian	8	HGDP (Zheng et al., 2014)
Chinese Dai	East/South East Asian	98	Sudmant et al., 2015
Chinese Han	East/South East Asian	103	Sudmant et al., 2015
Kho	South Asian	148	Our data (Rahman et al., unpublished)
Danish	European	20	Batini et al., 2017
Daur	East/South East Asian	10	HGDP (Zheng et al., 2014)
Druze	Middle East & Caucasus	47	HGDP (Zheng et al., 2014)
East Pamir Kyrgyz	Central Asian	68	Peng et al., 2018
English	European	20	Batini et al., 2017
Finnish	European	99	Sudmant et al., 2015

French	European		28	HGDP (Zheng et al., 2014)
Frisian	European		20	Batini et al., 2017
Georgian	Middle East & Caucasus		28	Schönenberg et al., 2011
Greeks	Eastern European & Siberia		20	Batini et al., 2017
Gujrati	South Asian		106	Sudmant et al., 2015
Hazara	South Asian		25	HGDP (Zheng et al., 2014)
Hungarian	Eastern European & Siberia		20	Batini et al., 2017
Iberian	European		107	Sudmant et al., 2015
Iranian	Middle East & Caucasus		30	Schönenberg et al., 2011
Iranian- Azeri	Middle East & Caucasus		22	Derenko et al., 2013
Iranian- Bakhtiari	Middle East & Caucasus		2	Derenko et al., 2013
Iranian- Gilak	Middle East & Caucasus		2	Derenko et al., 2013
Iranian- Indian	Middle East & Caucasus		1	Derenko et al., 2013
Iranian- Khalaj	Middle East & Caucasus		2	Derenko et al., 2013
Iranian- Khorasani	Middle East & Caucasus		4	Derenko et al., 2013
Iranian- Kurd	Middle East & Caucasus		5	Derenko et al., 2013
Iranian- Lur	Middle East & Caucasus		5	Derenko et al., 2013
Iranian- Mazandarani	Middle East & Caucasus		4	Derenko et al., 2013
Iranian- Persian	Middle East & Caucasus		181	Derenko et al., 2013
Iranian- Qashqai	Middle East & Caucasus		112	Derenko et al., 2013

	Caucasus				
Iranian- Turkmen	Middle East & Caucasus	2		Derenko et al., 2013	
Iranian-Armenian	Middle East & Caucasus	10		Derenko et al., 2013	
Irish	European	20		Batini et al., 2017	
Japanese	East/South East Asian	104		Sudmant et al., 2015	
Kalash	South Asian	9		Our data (Rahman et al., unpublished)	
Kalash	South Asian	25		HGDP (Zheng et al., 2014)	
Kashmiri	South Asian	78		Sharma et al., 2018	
Kinh	East/South East Asian	99		Sudmant et al., 2015	
Lipka Tatars	Eastern European & Siberia	11		Pankratov et al., 2016	
Lowland Kyrgyz	Central Asian	54		Peng et al., 2018	
Lowland Tajik	Central Asian	28		Peng et al., 2018	
Lowland Uygur	East/South East Asian	27		Peng et al., 2018	
Makrani	South Asian	24		HGDP (Zheng et al., 2014)	
Mongols	East/South East Asian	10		HGDP (Zheng et al., 2014)	
Norwegian	European	20		Batini et al., 2017	
Orcadian	European	16		HGDP (Zheng et al., 2014)	
Orcadian	European	20		Batini et al., 2017	
Palestinian	Middle East & Caucasus	50		HGDP (Zheng et al., 2014)	
Palestinian	Middle East & Caucasus	20		Batini et al., 2017	
Pamiri Tajik	Central Asian	50		Peng et al., 2018	
Pathan	South Asian	52		Our data (Rahman et al., unpublished)	
Pathan	South Asian	21		HGDP (Zheng et al., 2014)	
Polish	Eastern European & Siberia	100		Malyarchuk et al., 2017	

Punjabi-Pakistan		South Asian		96	Sudmant et al., 2015
Russian		Eastern European & Siberia		41	Malyarchuk et al., 2017
Russian		Eastern European & Siberia		46	Malyarchuk et al., 2017
Russian		Eastern European & Siberia		45	Malyarchuk et al., 2017
Russian		Eastern European & Siberia		51	Malyarchuk et al., 2017
Russian		Eastern European & Siberia		45	Malyarchuk et al., 2017
Russian		Eastern European & Siberia		61	Malyarchuk et al., 2017
Russian		Eastern European & Siberia		25	HGDP (Zheng et al., 2014)
Saami		European		20	Batini et al., 2017
Sardinian		European		2092	Olivieri et al., 2017
Sarikoli Tajik		Central Asian		86	Peng et al., 2018
Serbian		European		20	Batini et al., 2017
Sherpa		East/South East Asian		76	Kang et al., 2013
Sindhi		South Asian		25	HGDP (Zheng et al., 2014)
Southern Chinese	Han	East/South East Asian		104	Sudmant et al., 2015
Spanish		European		20	Batini et al., 2017
Srilankan Tamil		South Asian		102	Sudmant et al., 2015
Telugu		South Asian		103	Sudmant et al., 2015
Toscani		European		107	Sudmant et al., 2015
Turkish		Middle East & Caucasus		29	Schönberg et al., 2011
Turkish		Middle East & Caucasus		20	Batini et al., 2017
Utah		European		61	Sudmant et al., 2015

Uyghur	East/South East Asian	9	HGDP (Zheng et al., 2014)
Wakhi Tajik	Central Asian	66	Peng et al., 2018
West Pamir Kyrgyz	Central Asian	3	Peng et al., 2018
Xibo	East/South East Asian	8	HGDP (Zheng et al., 2014)
Yakut	Eastern European & Siberia	24	HGDP (Zheng et al., 2014)
Yemni	Middle East & Caucasus	113	Vyas et al., 2016

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Supplementary Table S2 Accession numbers and information of mitogenome sequences used for phylogeographic reconstruction of haplogroups in Kalash population

Code	Accession number/ID	Geographic origin	References
52	MN595769/CHM192	South Asia	Our data (Rahman et al., unpublished)
49	MN595685/CHF101	South Asia	Our data (Rahman et al., unpublished)
55	MN595749/CHF85	South Asia	Our data (Rahman et al., unpublished)
54	MN595765/CHM120	South Asia	Our data (Rahman et al., unpublished)
56	MN595818/CHM90	South Asia	Our data (Rahman et al., unpublished)
2	MN595718/CHF184	South Asia	Our data (Rahman et al., unpublished)
97	MN595807/CHM71	South Asia	Our data (Rahman et al., unpublished)
93	MN595706/CHF160	South Asia	Our data (Rahman et al., unpublished)
141	MN595751/CHF96	South Asia	Our data (Rahman et al., unpublished)
138	MN595890/PAM317	South Asia	Our data (Rahman et al., unpublished)
132	MN595820/CHM92	South Asia	Our data (Rahman et al., unpublished)
127	JX462724	South Asia	Khan et al., 2012
136	KF450841	South Asia	Lippold et al., 2014
73	AY714022. 1	South Asia	Palanichamy et al., 2004
108	KF450905. 1	South Asia	Lippold et al., 2014
53	KAM4	South Asia	Our data (Rahman et al., unpublished)
7	KAM7	South Asia	Our data (Rahman et al., unpublished)
8	KAM9	South Asia	Our data (Rahman et al., unpublished)
117	KAM6	South Asia	Our data (Rahman et al., unpublished)
145	KAM8	South Asia	Our data (Rahman et al., unpublished)
146	KAM5	South Asia	Our data (Rahman et al., unpublished)
163	KAF12	South Asia	Our data (Rahman et al., unpublished)
57	KF450963	South Asia	Lippold et al., 2014
12	KF450971. 1	South Asia	Lippold et al., 2014
9	KF450972. 1	South Asia	Lippold et al., 2014

10	KF450974. 1	South Asia	Lippold et al., 2014
11	KF450982. 1	South Asia	Lippold et al., 2014
14	EU597493. 1	South Asia	Hartmann et al., 2009
20	KF450968. 1	South Asia	Lippold et al., 2014
19	KF450986. 1	South Asia	Lippold et al., 2014
16	KF450967. 1	South Asia	Lippold et al., 2014
15	KF450980. 1	South Asia	Lippold et al., 2014
83	KF450975. 1	South Asia	Lippold et al., 2014
95	KF450979. 1	South Asia	Lippold et al., 2014
94	KF450984. 1	South Asia	Lippold et al., 2014
92	KF450983. 1	South Asia	Lippold et al., 2014
142	KF450977	South Asia	Lippold et al., 2014
143	KF450978	South Asia	Lippold et al., 2014
144	EU597564	South Asia	Hartmann et al., 2009
147	KF450973	South Asia	Lippold et al., 2014
140	KF450976	South Asia	Lippold et al., 2014
133	EU597575	South Asia	Hartmann et al., 2009
162	KF450970. 1	South Asia	Lippold et al., 2014
113	JX462708	South Asia	Khan et al., 2012
126	KC990673	South Asia	Ramanan et al., 2013
59	MF523044	Central Asia	Peng et al., 2018
60	MF523045	Central Asia	Peng et al., 2018
61	MF523046	Central Asia	Peng et al., 2018
58	MF523052	Central Asia	Peng et al., 2018
68	MF523033	Central Asia	Peng et al., 2018
100	MF523063. 1	Central	Peng et al., 2018

		Asia	
128	KX675279	Central Asia	Marchi et al., 2017
155	MF522979. 1	Central Asia	Peng et al., 2018
98	MF523059	Central Asia	Peng et al., 2018
99	MF523064. 1	Central Asia	Peng et al., 2018
96	MF523030	Central Asia	Peng et al., 2018
112	MF523127.1	East Asia	Peng et al., 2018
21	MF522857	East Asia	Peng et al., 2018
22	MF523082	East Asia	Peng et al., 2018
23	MF523123	East Asia	Peng et al., 2018
24	MF523124	East Asia	Peng et al., 2018
25	MF523132	East Asia	Peng et al., 2018
26	MF523135	East Asia	Peng et al., 2018
27	MF523182	East Asia	Peng et al., 2018
28	MF523202	East Asia	Peng et al., 2018
50	MF523165	East Asia	Peng et al., 2018
51	MF523217	East Asia	Peng et al., 2018
69	MF522925	East Asia	Peng et al., 2018
29	MF523180	East Asia	Peng et al., 2018
30	MF523206	East Asia	Peng et al., 2018
17	MF523176. 1	East Asia	Peng et al., 2018
18	MF523220. 1	East Asia	Peng et al., 2018
91	MF522922. 1	East Asia	Peng et al., 2018
107	KF849954. 1	East Asia	Jiang et al., 2014
110	KU683218. 1	East Asia	Zheng et al., 2017
111	KU683284. 1	East Asia	Zheng et al., 2017

101	MF523188. 1	East Asia	Peng et al., 2018
102	MF523134. 1	East Asia	Peng et al., 2018
137	MF522903	East Asia	Peng et al., 2018
134	MF523077	East Asia	Peng et al., 2018
135	MF523119	East Asia	Peng et al., 2018
152	MG952837. 1	East Asia	Malyarchuk et al., 2018
158	KU682886. 1	East Asia	Zheng et al., 2017
159	KU682905. 1	East Asia	Zheng et al., 2017
160	KU682920	East Asia	Zheng et al., 2017
161	KU682931	East Asia	Zheng et al., 2017
37	HM852854	Middle East and Caucasus	Schönberg et al., 2011
5	KX499665. 1	Middle East and Caucasus	Greenspan, FTDNA
4	KP407079. 1	Middle East and Caucasus	Gandini et al., 2016
13	KP407080. 1	Middle East and Caucasus	Gandini et al., 2016
1	KJ716336. 1	Middle East and Caucasus	Greenspan, FTDNA
89	JQ798052. 1	Middle East and Caucasus	Pala et al., 2012
84	AY495304. 1	Middle East and Caucasus	Coble et al., 2004
131	HM852776	Middle East and Caucasus	Schönberg et al., 2011

157	KC911400.1	Middle East and Caucasus	Derenko et al., 2013
72	AY495298.1	Middle East and Caucasus	Coble et al., 2004
64	KY670917	Eastern Europe and Siberia	Malyarchuk et al., 2017
31	KJ856689	Eastern Europe and Siberia	Derenko et al., 2014
32	KJ856717	Eastern Europe and Siberia	Derenko et al., 2014
33	KJ856745	Eastern Europe and Siberia	Derenko et al., 2014
82	FJ656215.1	Eastern Europe and Siberia	Rogaev et al., 2009
109	FJ493504.1	Eastern Europe and Siberia	Sukernik et al., 2012
139	KJ856729	Eastern Europe and Siberia	Derenko et al., 2014
118	MG597495	Eastern Europe and Siberia	Greenspan, FTDNA
151	FJ147313.1	Eastern Europe and Siberia	Sukernik et al., 2012
156	FJ147316.1	Eastern Europe and Siberia	Sukernik et al., 2012
153	FJ147314.1	Eastern Europe and	Sukernik et al., 2012

		Siberia	
63	KF162320	Europe	Li et al., 2014
48	KY646099	Europe	Greenspan, FTDNA
36	KF162914	Europe	Li et al., 2014
35	KY399164	Europe	Olivieri et al., 2017
43	KM016488	Europe	Greenspan, FTDNA
34	AY339428	Europe	Moilanen et al., 2003
3	KP407078. 1	Europe	Gandini et al., 2016
6	KF055865. 1	Europe	Gómez-Carballa et al., 2013
90	JQ798053. 1	Europe	Pala et al., 2012
88	JX297195. 1	Europe	Cardoso et al., 2013
87	JX297194. 1	Europe	Cardoso et al., 2013
77	KF161904. 1	Europe	Li et al., 2014
106	EF660957. 1	Europe	Gasparre et al., 2007
105	KF161734. 1	Europe	Li et al., 2014
104	JN581653. 1	Europe	Bertolin et al., 2011
103	KJ856797. 1	Europe	Derenko et al., 2014
115	KF161136. 1	Europe	Li et al., 2014
116	MG952848. 1	Europe	Malyarchuk et al., 2018
130	KF161730	Europe	Li et al., 2014
129	KF161522	Europe	Li et al., 2014
124	KF161073	Europe	Li et al., 2014
123	KF161338	Europe	Li et al., 2014
122	KF162533	Europe	Li et al., 2014
121	KF451618	Europe	Lippold et al., 2014
125	KP733895	Europe	Greenspan, FTDNA
120	MG669471	Europe	Greenspan, FTDNA
119	KF161335	Europe	Li et al., 2014
154	MG952787. 1	Europe	Malyarchuk et al., 2018

70	JN383991. 1	Europe	Greenspan, FTDNA
71	KC137255. 1	Europe	Greenspan, FTDNA
67	HQ667351	Out of Eurasia	Greenspan, FTDNA
42	FJ668389	Out of Eurasia	Greenspan, FTDNA
66	JQ702059	unknown	Behar et al., 2012
65	JQ703017	unknown	Behar et al., 2012
62	JQ703213	unknown	Behar et al., 2012
45	MF497500	unknown	Järviaho et al., 2018
44	JQ702397	unknown	Behar et al., 2012
47	MF497516	unknown	Järviaho et al., 2018
46	MF497515	unknown	Järviaho et al., 2018
40	JQ703144	unknown	Behar et al., 2012
41	JQ705852	unknown	Behar et al., 2012
39	JQ704579	unknown	Behar et al., 2012
38	KJ801443	unknown	Lang et al., 2015
86	JQ702379. 1	unknown	Behar et al., 2012
85	JQ702594. 1	unknown	Behar et al., 2012
81	JQ702611. 1	unknown	Behar et al., 2012
80	JQ705057. 1	unknown	Behar et al., 2012
79	JQ705133. 1	unknown	Behar et al., 2012
78	JQ703890. 1	unknown	Behar et al., 2012
74	JQ702969. 1	unknown	Behar et al., 2012
76	JQ706008. 1	unknown	Behar et al., 2012
75	JQ703088. 1	unknown	Behar et al., 2012
149	JQ704215	unknown	Behar et al., 2012
150	JQ703947	unknown	Behar et al., 2012
148	JQ703903	unknown	Behar et al., 2012
114	JQ705900	unknown	Behar et al., 2012

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Supplementary Table S3 GenBank accession Nos. and information of mitogenome sequences used for phylogeographic reconstruction of J2b1a using reduced median-joining network. Accession numbers of ancient mitogenomes are in italics

GenBank accession No./ID	Haplogroup	Country	Geographic region	References
KAF1	J2b1a	North Pakistan	South Asia	Our data (Rahman et al., unpublished)
KAM2	J2b1a	North Pakistan	South Asia	Our data (Rahman et al., unpublished)
DQ341090. 1	J2b1a	Italy	Europe	Carelli et al., 2006
DQ523671. 1	J2b1a	Sardinia	Europe	Fraumene et al., 2006
EU597520. 1	J2b1a	Sardinia	Europe	Hartmann et al., 2009
EU673448. 1	J2b1a	NA	NA	Greenspan, FTDNA

JF915700. 1	J2b1a	Ireland	Europe	Greenspan, FTDNA
JN635304. 1	J2b1a	NA	NA	Pacheu-Grau et al., 2013
JQ702196. 1	J2b1a	NA	NA	Behar et al., 2012
JQ702199. 1	J2b1a	NA	NA	Behar et al., 2012
JQ702442. 1	J2b1a	NA	NA	Behar et al., 2012
JQ702477. 1	J2b1a	NA	NA	Behar et al., 2012
JQ702553. 1	J2b1a	NA	NA	Behar et al., 2012
JQ702593. 1	J2b1a	NA	NA	Behar et al. 2012
JQ702758. 1	J2b1a	NA	NA	Behar et al., 2012
JQ703517. 1	J2b1a	NA	NA	Behar et al., 2012
JQ705925. 1	J2b1a	NA	NA	Behar et al., 2012
JQ797939. 1	J2b1a	Italy	Europe	Pala et al., 2012
JQ797942. 1	J2b1a	Morocco	Others	Pala et al., 2012
JQ797947. 1	J2b1a	Italy	Europe	Pala et al., 2012
JQ797948. 1	J2b1a	Italy	Europe	Pala et al., 2012
JX152794. 1	J2b1a	Denmark	Europe	Raule et al., 2014
JX153193. 1	J2b1a	Finland	Europe	Raule et al., 2014
JX153750. 1	J2b1a	Denmark	Europe	Raule et al., 2014
KF161080. 1	J2b1a	Denmark	Europe	Li et al., 2014
KF161168. 1	J2b1a	Denmark	Europe	Li et al., 2014
KF161362. 1	J2b1a	Denmark	Europe	Li et al., 2014
KF161505. 1	J2b1a	Denmark	Europe	Li et al., 2014
KF161527. 1	J2b1a	Denmark	Europe	Li et al., 2014
KF450954. 1	J2b1a	North Pakistan	South Asia	Lippold et al., 2014
KF450956. 1	J2b1a	North Pakistan	South Asia	Lippold et al., 2014
KF450962. 1	J2b1a	North Pakistan	South Asia	Lippold et al., 2014
KF450969. 1	J2b1a	North Pakistan	South Asia	Lippold et al., 2014
KF450981. 1	J2b1a	North Pakistan	South Asia	Lippold et al., 2014

KF450985. 1	J2b1a	North Pakistan	South Asia	Lippold et al., 2014
KF451585. 1	J2b1a	Sardinia	Europe	Lippold et al., 2014
KM101817. 1	J2b1a	America	Others	Just et al., 2015
KM101927. 1	J2b1a	America	Others	Just et al., 2015
KM101985. 1	J2b1a	America	Others	Just et al., 2015
KX440268. 1	J2b1a	Morocco	Others	Pereira et al., 2017
KX440269. 1	J2b1a	Tunisia	Others	Pereira et al., 2017
KX440270. 1	J2b1a	Morocco	Others	Pereira et al., 2017
KY399150. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY399160. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY408236. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY408253. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY408272. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY408304. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY408322. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY408330. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY408334. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY408342. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY408345. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY408364. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY408367. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY408382. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY408391. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY408414. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY408425. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY408441. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY408449. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY408469. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY408507. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017

KY408562. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY408599. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY408728. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY408803. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY408858. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY408875. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY408958. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY408969. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY409023. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY409032. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY409051. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY409062. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY409064. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY409077. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY409095. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY409114. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY409118. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY409139. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY409149. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY409202. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY409316. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY409330. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY409435. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY409470. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY409521. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY409688. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY409706. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY409769. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY409828. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017

KY409831. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY409967. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY410016. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY410037. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY410114. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY410121. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY410151. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY410222. 1	J2b1a	Sardinia	Europe	Olivieri et al., 2017
KY670914. 1	J2b1a	Russia	Eastern Europe and Siberia	Malyarchuk et al., 2017
<i>MF498701. 1</i>	J2b1a	Germany	Europe	Knipper et al., 2017
<i>MF991442. 1</i>	J2b1a	Spain	Europe	Fregel et al., 2018
<i>MF991447. 1</i>	J2b1a	Spain	Europe	Fregel et al., 2018
MK239957. 1	J2b1a	Ireland	Europe	Greenspan, FTDNA
HG00106	J2b1a	England and Scotland	Europe	Sudmant et al., 2015
<i>I1109</i>	J2b1	Bulgaria	Eastern Europe and Siberia	Mathieson et al., 2018
<i>I2216</i>	J2b1	Bulgaria	Eastern Europe and Siberia	Mathieson et al., 2018
<i>KX354973. 1</i>	J2b1	Italy	Europe	Modi et al., 2017
<i>LHSZ5</i>	J2b1	Hungary	Europe	Vai et al., 2019
<i>SZ5</i>	J2b1	Hungary	Europe	Amorim et al., 2018

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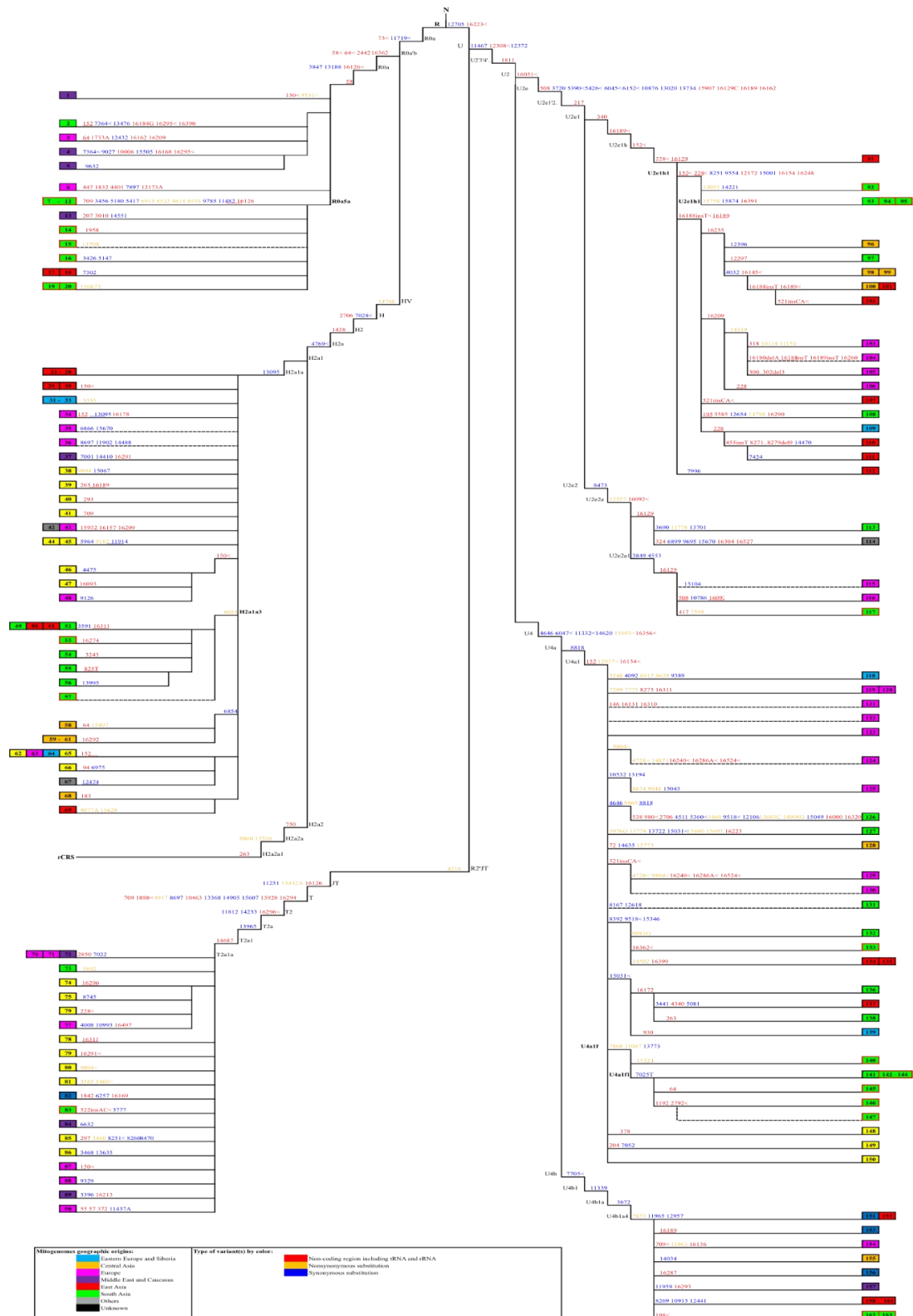
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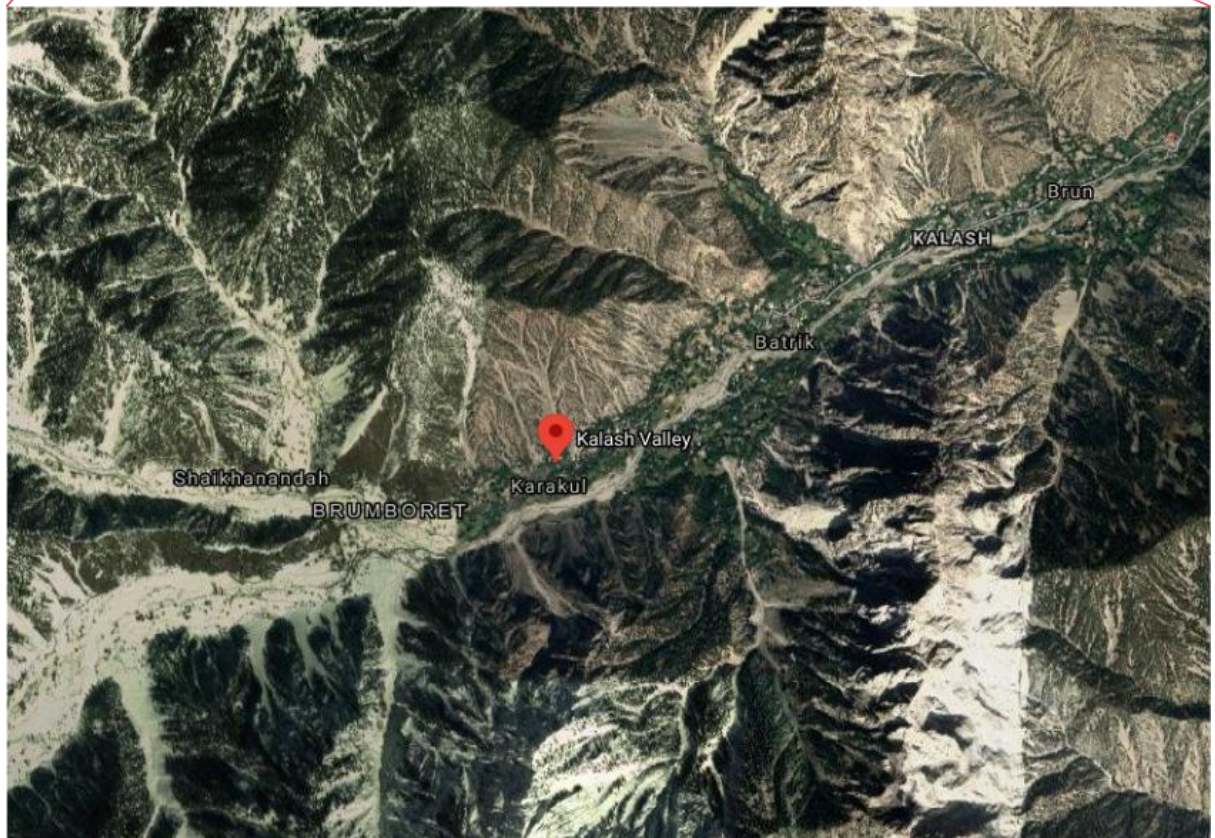
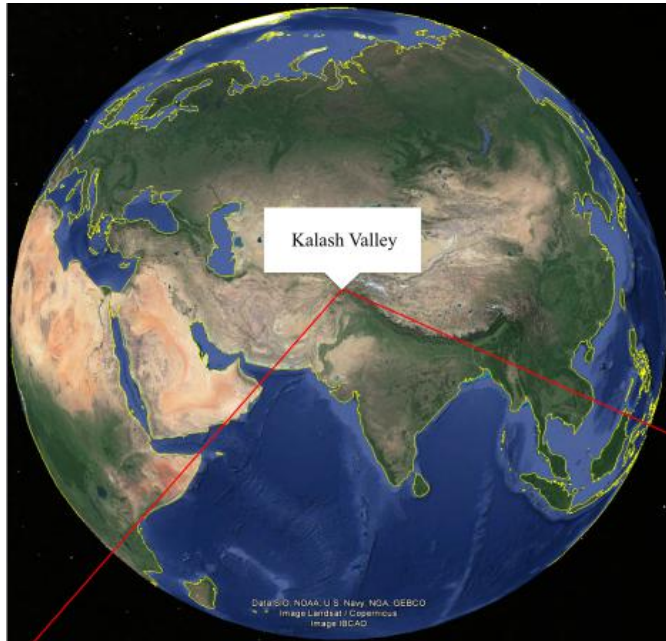
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Supplementary Figures



Supplementary Figure S1 Maximum-parsimony phylogenetic reconstruction of haplogroups identified in Kalash population together with available mitogenome data from our unpublished work and literature. Geographic affiliation of sequences is represented by different colors, as shown in legend. Mutations are shown on tree branches relative to the

rCRS, and recurrent mutations are shown with underlined numbers. Each square block corresponds to a mitogenome sequence with the codes correspond to those in Supplementary Table S2; Kalash sequences are enclosed in red squares. Newly defined haplogroups in our study are in bold. Sequences from outside Eurasia are labeled as “Others” in brown; sequences of unknown origin are labeled as “Unknown” in yellow. Types of variants are shown in different colors, as defined in the figure legend. All transversions are shown with their respective nucleotide types. Branches with incomplete mitogenome sequence(s) with gap(s) are shown with dotted lines and their positions in the tree are uncertain.



Supplementary Figure S2 Sampling locations in Kalash valleys of northern Pakistan are pinned on the map. Upper right inset shows a Kalash child in traditional Kalash dress (photo reproduced from <https://www.flickr.com/> with author's permission).