

Appendices

Appendice A. Geological sample locations with latitude and longitude of the Keonjhar Quartzite, north of Keonjhar town that are used for petrography and geochemistry.

Location No.	Latitude	Longitude	Location No.	Latitude	Longitude
KNJ-48	21°44'54.1"	85°20'4.3"	KNJ-114	21°58'59.7"	85°30'54.8"
KNJ-49	21°50'6.2"	85°28'7.5"	KNJ-115	21°53'13.6"	85°29'20.1"
KNJ-61	21°50'6.3"	85°28'6.9"	KNJ-116	21°53'30.8"	85°29'34.3"
KNJ-62	21°52'42.8"	85°30'29.8"	KNJ-117	21°56'0.91"	85°29'24.5"
KNJ-64	21°52'45.9"	85°30'2.9"	KNJ-118	21°56'26.4"	85°29'13.4"
KNJ-65	21°51'57.5"	85°32'14.8"	KNJ-120	21°57'32.1"	85°29'51.9"
KNJ-66	21°52'42.7"	85°30'15.6"	KNJ-121	21°57'44"	85°28'36"
KNJ-67	21°52'49.3"	85°29'19.9"	KNJ-122	21°56'50.3"	85°28'32.9"
KNJ-68	21°54'20.1"	85°29'49.7"	KNJ-123	21°56'51.7"	85°28'20.4"
KNJ-69	21°54'41.7"	85°29'35.3"	KNJ-124	21°56'33.0"	85°28'10.6"
KNJ-69A	21°55'19.9"	85°29'33"	KNJ-125	21°56'24.2"	85°28'1.6"
KNJ-70	21°53'51.3"	85°29'7.5"	KNJ-126	21°56'30.0"	85°27'32.2"
KNJ-71	21°55'46.1"	85°27'41.2"	KNJ-127	21°56'38.3"	85°26'47.7"
KNJ-73	21°57'13"	85°30'5.7"	KNJ-128	21°56'1.2"	85°27'17.3"
KNJ-74	21°57'16.4"	85°30'13.7"	KNJ-129	21°55'47.6"	85°27'46.5"
KNJ-75	21°58'9.8"	85°29'39.5"	KNJ-130	21°54'50.8"	85°28'26.9"
KNJ-76	21°58'49.5"	85°29'26.9"	KNJ-131	21°53'54.1"	85°29'8.2"
KNJ-78	21°59'52.8"	85°28'40.9"	KNJ-132	21°52'58.5"	85°28'49.5"
KNJ-79	21°59'57.2"	85°29'2.6"	KNJ-133	21°52'15.6"	85°29'46"
KNJ-80	22°00'3.0"	85°29'43.9"	KNJ-134	21°51'34.9"	85°30'0.3"
KNJ-81	22°00'5.5"	85°29'51.7"	KNJ-135	21°50'58.3"	85°30'19.1"
KNJ-82	21°49'22.1"	85°30'28.6"	KNJ-136	21°51'07.6"	85°30'01.9"
KNJ-83	21°49'25.9"	85°30'11.3"	KNJ-137	21°51'12.4"	85°29'21.3"
KNJ-84	21°49'21"	85°29'26.8"	KNJ-138	21°51'19.6"	85°29'13"
KNJ-85	21°48'50.1"	85°29'33"	KNJ-139	21°49'42.1"	85°29'2.3"
KNJ-86	21°48'31.1"	85°28'49.6"	KNJ-140	21°49'27.0"	85°29'12.6"
KNJ-87	21°48'55.8"	85°27'50"	KNJ-141	21°49'35.9"	85°29'9.1"
KNJ-88	21°50'35.4"	85°28'4.6"	KNJ-142	21°49'46.9"	85°28'41.6"
KNJ-89	21°52'10.6"	85°27'0.2"	KNJ-143	21°50'56.2"	85°30'6.7"
KNJ-90	21°52'26"	85°26'58"	KNJ-144	21°51'7.2"	85°30'2.0"
KNJ-91	21°53' 30.72"	85°28'42.84"	KNJ-145	21°51'11.1"	85°29'54.5"
KNJ-92	21°53' 18.3"	85°27' 52.8"	KNJ-146	21°51'12.8"	85°29'40.1"
KNJ-94	21°55'14.28"	85°29'31.38"	KNJ-147	21°51'11.9"	85°29'22.2"
KNJ-95	21°55'7.02"	85°29'33.24"	KNJ-148	21°49'1.5"	85°27'24.7"
KNJ-96	21°57'14.28"	85°29'18.78"	KNJ-149	21°50'07.6"	85°26'49.1"
KNJ-97	21°57' 12.8"	85°30'			
KNJ-98	21°56'58.6"	85°30'40.0"			
KNJ-99	21°56'32.4"	85°31'3.4"			
KNJ-100	21°55'44.9"	85°31'35.6"			
KNJ-101	21°55'10.5"	85°32'5"			
KNJ-102	21°57'47.5"	85°25'59.6"			
KNJ-103	21°58'20"	85°25'29.7"			
KNJ-104	21°59'9.7"	85°29'36.5"			
KNJ-105	21°59'25.1"	85°29'38.2"			
KNJ-106	21°59'46.9"	85°29'33.1"			
KNJ-107	21°59'32.8"	85°28'27.1"			
KNJ-108	21°55'54.9"	85°32'13"			
KNJ-110	21°55'0.79"	85°32'10.0"			
KNJ-111	21°48'24.4"	85°27'56.3"			
KNJ-112	21°57'56.1"	85°32'21.5"			
KNJ-113	21°58'35.1"	85°31'48.6"			

Appendix B. Results of rock standard analyses used for XRF analyses of major elements.

Major oxides	Certified value (JG-2)	Analyzed value (JG-2)	Certified value (NIM G)	Analyzed value (NIM G)
SiO ₂	76.95	76.45	75.70	75.56
Al ₂ O ₃	12.41	12.22	12.08	11.87
Fe ₂ O ₃	0.92	0.78	2.02	1.98
MnO	0.015	0.011	0.02	0.01
MgO	0.04	0.04	0.06	0.57
CaO	0.8	0.79	0.78	0.73
Na ₂ O	3.55	3.41	3.36	3.29
K ₂ O	4.72	4.59	4.99	4.78
TiO ₂	0.04	0.03	0.09	0.077
P ₂ O ₅	0.002	0.001	0.01	0.01

Appendix C. Results of rock standard analyses used for trace and rare earth elements.

Trace and REE Elements	GSR-5 (shale)		JG-2 (granite)	
	Certified value	Analyzed value	Certified value	Analyzed value
Sc	18.5	18.5	2.5	2.33
V	87	87.3	3.0	2.91
Cr	99	98.9	7.6	7.92
Co	21	21.0	4.3	4.55
Ni	36.8	36.6	2.1	2.01
Cu	42	41.9	0.4	0.38
Zn	55	54.6	12.7	13.07
Ga	25.6	25.8	19.0	20.1
Rb	205	204.6	297.0	306.22
Sr	90	89.4	16.0	18.21
Y	26	26.0	88.2	86.79
Zr	96	96.2	101.0	105.71
Nb	14.3	14.2	15.0	14.55
Cs	14	13.8	7.5	7.55
Ba	450	448.5	67.0	69.09
Hf	2.9	2.8	5.4	5.27
Ta	1	1.0	1.9	1.9
Pb	8.7	8.7	32.8	33.76
Th	12.8	12.8	29.7	29.93
U	1.5	1.5	12.5	13.01
La	62	61.8	20.1	20.51
Ce	109	108.7	49.5	50.01
Pr	13.6	13.7	6.0	6.22
Nd	48	47.9	25.8	25.6
Sm	8.4	8.7	7.7	7.67
Eu	1.7	1.7	0.1	0.08
Gd	6.7	6.7	7.1	7.07
Tb	1.02	1.03	1.50	1.45
Dy	5.1	5.1	11.5	10.78
Ho	0.98	0.98	1.40	1.47
Er	2.7	2.7	5.0	4.88
Tm	0.43	0.42	0.70	0.65
Yb	2.6	2.6	7.3	7.1
Lu	0.41	0.41	1.22	1.19
Total REE	262.64	262.44	144.92	144.68

Appendice D. Values of UCC, AUC, Chondrite and Singhbhum Granite (Saha 1994; Dey et al. 2017; McDonough and Sun 1995)

	SiO ₂	TiO ₂	Al ₂ O ₃	Fe ₂ O ₃	MnO	MgO	CaO	Na ₂ O	K ₂ O	P ₂ O ₅	Total
SBG Phase I											
852/60	72.67	0.66	14.75	3.106	0.04	0.74	2.27	3.42	2.28	0.2	100.14
874/61	69.45	0	16.23	3.096	0.04	0.4	2.61	3.84	4.44	0.05	100.16
P285	69.18	0.28	15.81	3.529	0.03	0.91	2.81	5.13	1.81	0.17	99.66
Mean	70.43	0.47	15.597	3.2437	0.04	0.683	2.5633	4.13	2.8433	0.14	100.14
SBG Phase II											
R371	72.32	-	15.18	2.58	0.05	0.66	2.26	3.83	3.22	0.03	100.13
R237	69.53	-	15.1	4.163	0.06	0.73	3.04	3.82	3.6	0.13	100.15
B82	69.62	0.3	16.68	3.225	0.09	1.07	2.19	3.29	3.37	0.3	99.65
M50	74.52	0.5	14.42	1.9	0.02	0.81	1.12	2.96	3.68	0.19	100.14
M21	74.16		16.08	0.898	0.05	0.69	1.68	3.31	2.6	0.02	100.13
K1	72.9	0.16	14.37	1.35	0.02	0.26	0.94	4.41	3.45	0.04	100.17
K2	72.6	0.18	13.91	1.75	0.02	0.39	1.4	4.64	3.25	0.05	100.13
K3	72.9	0.26	13.92	1.87	0.03	0.37	1.23	3.96	4.19	0.07	100.12
K4	72.3	0.18	14.64	1.76	0.03	0.45	2.03	4.89	2.05	0.06	99.49
K5	71.9	0.26	14.18	1.81	0.03	0.44	1.57	4.72	3.48	0.1	97.9
Mean	72.28	0.23	14.848	2.1306	0.04	0.587	1.746	3.983	3.289	0.099	98.19
SBG Phase III											
SG 333	74.77	0.38	16.28	1.267	0.14	0.32	0.82	3.02	3.6	0.18	100.78
JP1	75.89	0.14	14.73	0.628	0.05	0.18	0.6	3.3	4.5	0.02	100.04
JP 4	70.14	0.1	16.08	2.605	0.04	0.82	2.25	3.15	4.52	0.44	100.15
968/61	70.6	0.32	15.98	2.864	0.03	0.4	2.7	3.62	3.61	0.04	100.16
688/60	69.77	0.78	16.59	3.668	0.09	0.48	2.38	2.14	4.13	0.16	100.19
650/61	70.29	-	15.48	3.134	0.04	0.56	3.17	4.24	2.47	0.77	100.15
SR 563	67.57	0.22	17.68	2.355	0.02	0.73	1.8	4.52	5.21	-	100.11
SR172	70.84	0.51	14.39	1.97	0.04	0.29	1.8	6.33	3.92	0.01	100.1
SR588	73.68	0.19	13.43	1.499	0.06	0.59	0.74	5.34	4.54	0.03	100.1
Mean	71.51	0.33	15.627	2.2211	0.06	0.486	1.8067	3.9622	4.0556	0.2062	100.26
UCC	65.9	0.65	15.2	4.52	-	2.21	4.2	3.9	3.36	-	99.94
AUC	60.1	0.83	15.3	8	-	4.69	6.2	3.05	1.81	-	99.98

Appendix D. Continuation.....

	Sc	V	Cr	Co	Ni	Y	Zr	Hf	Th	U	Rb	Sr	Ba	Ga	Nb	Ta	Cu	Li	Pb
SBG Phase I																			
852/60	-	-	16.30	-	-	15.00	210.00	-	-	-	66.00	254.00	-	-	-	0.80	-	-	76.00
874/61	-	-	14.10	-	-	11.00	180.00	-	-	-	61.00	325.00	-	-	-	0.54	-	-	-
P285	-	31.00	3.00		8.00	20.00	95.00	-	-	-	165.00	380.00	290.00	14.00	-	-	5.00	148.00	-
Mean	-	31.00	11.13	0.00	8.00	15.33	161.67	-	-	-	97.33	319.67	290.00	14.00	-	0.67	5.00	148.00	76.00
SBG Phase II																			
R371	-	36.00	16.10	4.00	17.00	7.00	143.00	-	-	-	115.00	360.00	-	29.00	-	0.70	23.00	21.00	-
R237	-	53.00	19.90	6.00	38.00	12.00	150.00	-	-	-	94.00	612.00	-	25.00	-	0.99	56.00	20.00	-
B82	-	-	13.30	-	-	5.00	131.00	-	-	-	99.00	398.00	-	-	-	0.70	-	-	-
M50	-	-	12.00	-	-	4.00	90.00	-	-	-	132.00	237.00	589.00	-	-	0.27	-	-	-
M21	-	10.00	15.00	-	10.00	10.00	-	-	-	-	81.00	231.00	150.00	5.00	-	-	5.00	50.00	20.00
K1	-	16.00	160.00	1.90	3.20	5.80	135.00	-	-	-	83.00	338.00	446.00	16.40	-	0.30	2.40	-	11.30
K2	-	11.00	144.00	1.60	2.90	4.50	123.00	-	-	-	83.00	288.00	443.00	16.00	-	0.50	2.80	-	-
K3	-	17.00	151.00	2.70	5.00	5.20	208.00	-	-	-	101.00	273.00	476.00	15.60	-	0.30	2.80	-	-
K4	-	21.00	136.00	2.30	3.30	9.70	131.00	-	-	-	71.00	401.00	274.00	19.10	-	0.30	10.30	-	-
K5	-	18.00	154.00	2.80	4.10	7.50	144.00	-	-	-	93.00	449.00	712.00	16.80	-	0.40	40.50	-	-
Mean	-	22.75	82.13	3.04	10.44	7.07	139.44	-	-	-	95.20	358.70	441.43	17.86	-	0.50	17.85	30.33	15.65
SBG Phase III																			
SG 333	-	-	14.00	-	-	21.00	132.00	-	-	-	225.00	93.00	560.00	-	-	1.10	-	-	-
JP1	-	-	11.20	-	-	20.00	116.00	-	-	-	190.00	81.00	334.00	-	-	1.90	-	-	-
JP 4	-	-	16.80	-	-	18.00	168.00	-	-	-	140.00	300.00	-	-	-	1.90	-	-	-
968/61	-	20.00	19.90	4.00	4.00	13.00	170.00	-	-	-	75.00	183.00	668.00	14.00	-	0.60	4.00	12.00	-
688/60	-	19.00	16.40	4.00	15.00	18.00	209.00	-	-	-	87.00	230.00	414.00	16.00	-	0.81	3.00	13.00	-
650/61	-	26.00	13.30	4.00	15.00	12.00	195.00	-	-	-	72.00	326.00	-	11.00	-	1.07	6.00	18.00	-
SR 563	-	-	14.90	-	-	30.00	136.00	-	-	-	235.00	90.00	404.00	-	-	1.80	-	-	-
SR172	-	60.00	16.10	20.00	15.00	13.00	151.00	-	-	-	118.00	289.00	343.00	37.00	-	0.55	20.00	24.00	-
SR588	-	24.00	16.70	20.00	10.00	8.00	180.00	-	-	-	122.00	178.00	751.00	33.00	-	0.45	5.00	29.00	-
Mean	-	29.80	15.48	10.40	11.80	17.00	161.89	-	-	-	140.44	196.67	496.29	22.20	-	1.13	7.60	19.20	0.00
UCC	13.6	107	83	17	44	22	190	5.80	10.70	2.80	112	350	550	17	12	1	25	20	17
AUC	14.00	195.00	180.00	25.00	105.00	18.00	125.00	3.00	5.70	1.50	50.00	240.00	390.00	-	-	-	-	0.50	-

Appendix D. Continuation.....

	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Total REE
SBG Phase I															
852/60	53.70	102.50	-	32.30	5.80	1.04	-	0.60	-	-	-	-	1.10	0.22	197.26
874/61	45.70	80.00	-	26.50	5.00	1.10	-	0.47	-	-	-	-	0.90	0.14	159.81
P285	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean	49.70	91.25	-	29.40	5.40	1.07	-	0.54	-	-	-	-	1.00	0.18	178.54
SBG Phase II															
R371	29.50	54.30	-	16.50	2.70	0.70	-	0.20	-	-	-	-	0.80	0.10	104.8
R237	53.30	100.00	-	37.10	5.70	1.40	-	0.49	-	-	-	-	1.00	0.10	199.09
B82	18.20	48.40	-	16.60	2.50	0.67	-	0.14	-	-	-	-	-	0.09	86.6
M50	33.00	63.00	-	16.50	2.90	0.65	-	0.24	-	-	-	-	0.37	0.06	116.72
M21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
K1	32.00	59.00	-	18.70	2.48	0.55	-	0.21	-	-	-	-	0.41	0.06	113.41
K2	29.00	54.00	-	16.40	2.15	0.48	-	0.17	-	-	-	-	0.38	0.06	102.64
K3	55.00	111.00	-	36.50	4.66	0.77	-	0.32	-	-	-	-	0.33	0.05	208.63
K4	32.00	62.00	-	19.70	3.40	0.80	-	0.38	-	-	-	-	0.67	0.10	119.05
K5	42.00	81.00	-	19.20	2.72	0.73	-	0.32	-	-	-	-	0.48	0.06	146.51
Mean	36.00	70.30	-	21.91	3.25	0.75	-	0.27	-	-	-	-	0.49	0.08	133.05
SBG Phase III															
SG 333	49.00	75.00	-	24.40	5.00	0.53	-	0.28	-	-	-	-	2.00	0.29	156.5
JP1	36.40	62.10	-	-	3.90	0.36	-	0.47	-	-	-	-	2.30	0.34	105.87
JP 4	36.00	62.40	-	20.90	3.20	0.66	-	0.40	-	-	-	-	1.80	0.26	125.62
968/61	47.60	88.60	-	25.00	5.30	1.10	-	0.50	-	-	-	-	1.06	2.63	171.79
688/60	91.30	178.00	-	51.90	9.20	1.10	-	0.68	-	-	-	-	1.80	0.24	334.22
650/61	52.00	94.00	-	30.90	5.40	0.99	-	0.46	-	-	-	-	1.20	0.16	185.11
SR 563	53.00	96.00	-	27.20	5.30	0.54	-	0.70	-	-	-	-	3.40	0.52	186.66
SR172	22.00	42.80	-	-	2.63	0.47	-	0.24	-	-	-	-	0.80	0.11	69.05
SR588	51.80	95.00	-	-	4.80	0.76	-	0.33	-	-	-	-	1.10	0.14	153.93
Mean	48.79	88.21	-	20.03	4.97	0.72	-	0.45	-	-	-	-	1.72	0.52	165.41
UCC	30.00	64.00	7.1	26.00	4.50	0.88	3.80	0.64	3.50	0.80	2.30	0.33	2.20	0.32	146.37
AUC	20.00	42.00	4.9	20.00	4.00	1.20	3.40	0.57	3.40	0.74	2.10	0.30	2.00	0.31	104.92
Chondrite	0.3670	0.9570	0.1370	0.7110	0.2310	0.0870	0.3060	0.0580	0.3810	0.0851	0.2490	0.0356	0.2480	0.0381	3.89