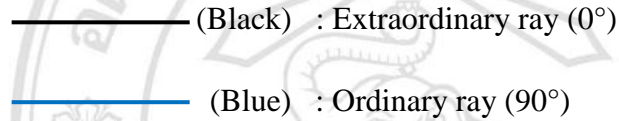


APPENDIX A

Ultraviolet-Visible-Near Infrared (UV-Vis-NIR) absorption spectra of green tourmalines from Madagascar, Mozambique and Tanzania

UV-Vis-NIR absorption spectra of green tourmalines from Madagascar, Mozambique and Tanzania were measured of the ordinary and extraordinary rays.

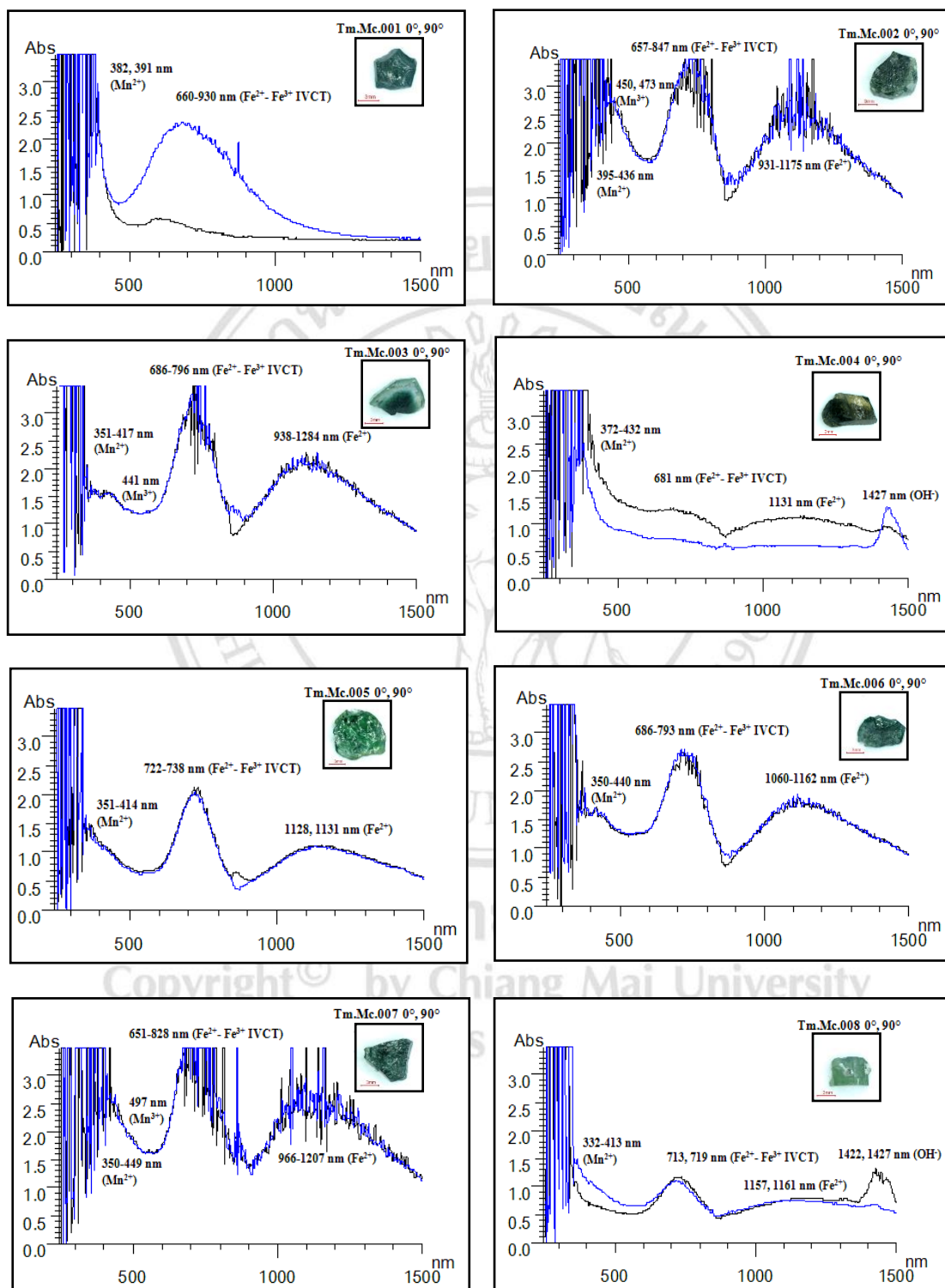


— (Black) : Extraordinary ray (0°)
— (Blue) : Ordinary ray (90°)

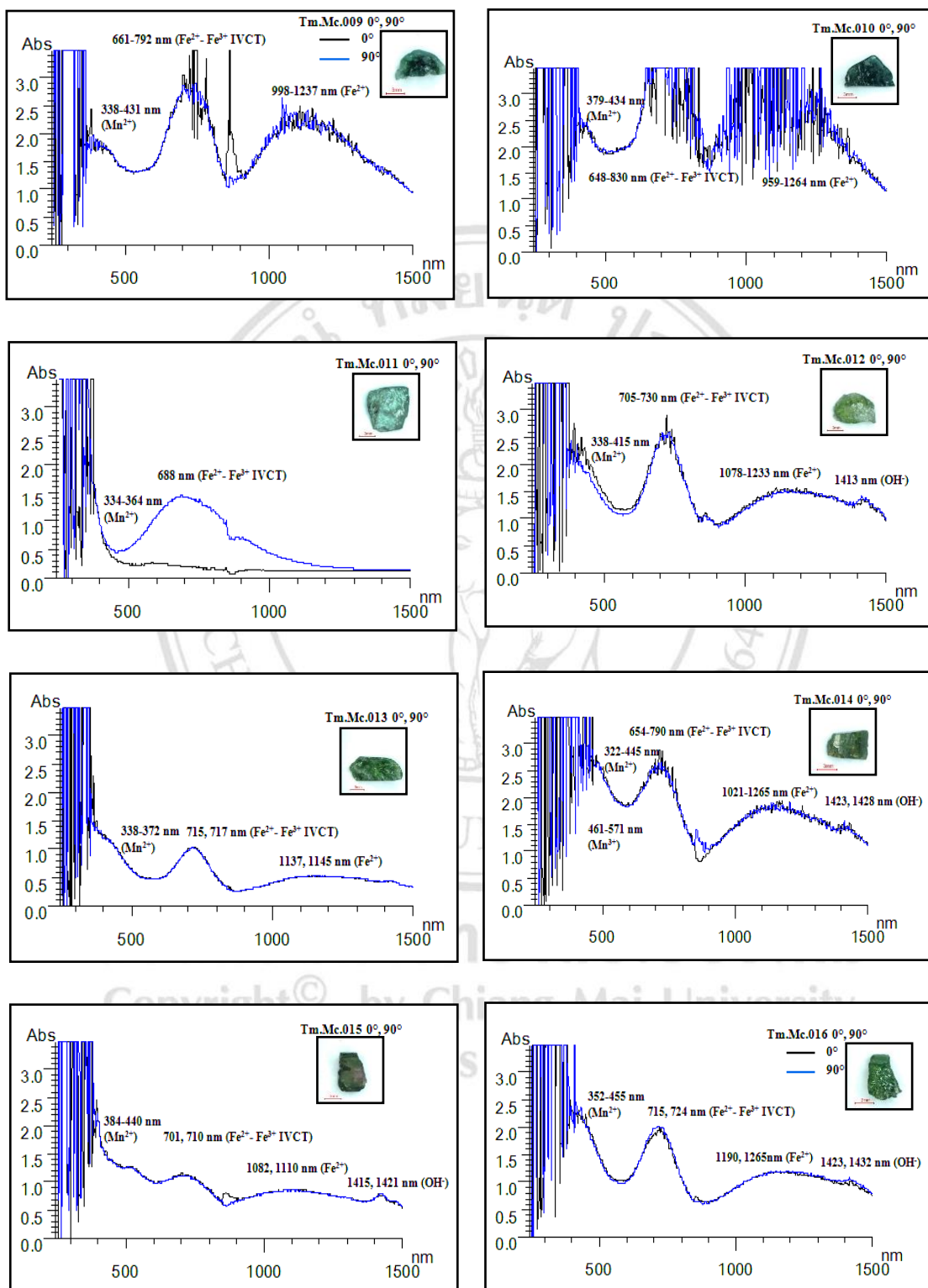


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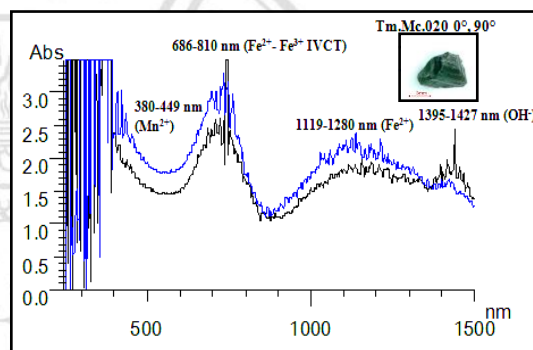
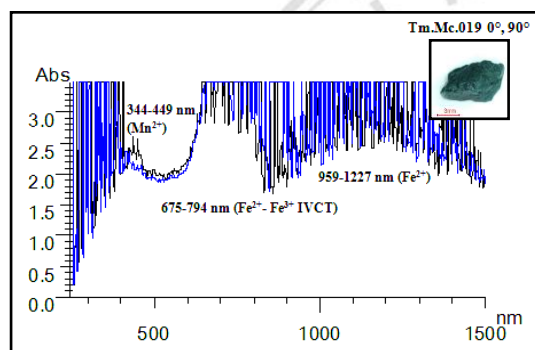
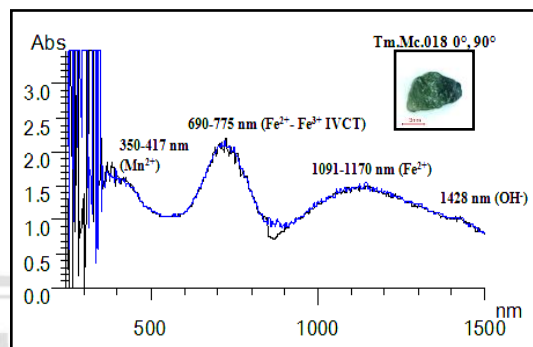
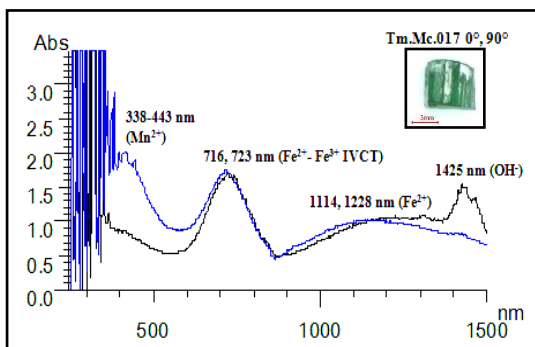
Appendix A UV-Vis-NIR absorption spectra of green tourmalines from Madagascar



Appendix A (continued).

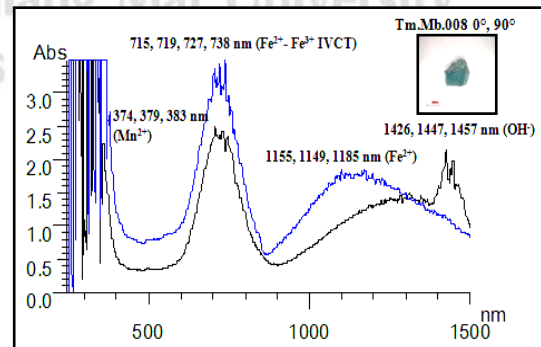
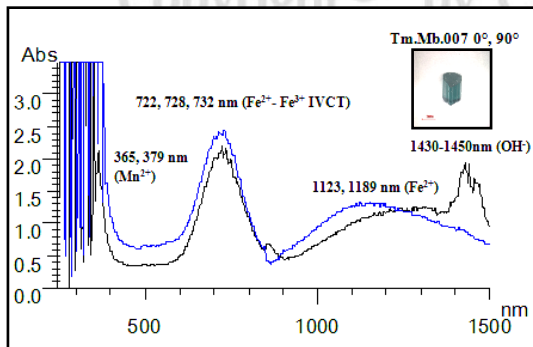
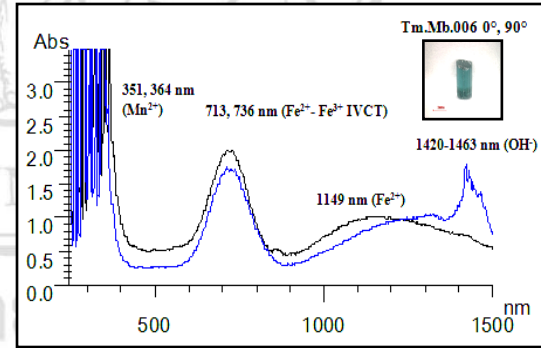
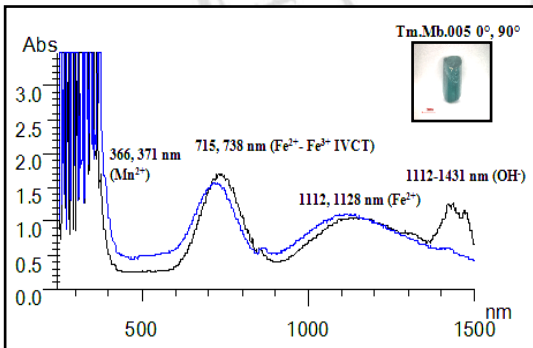
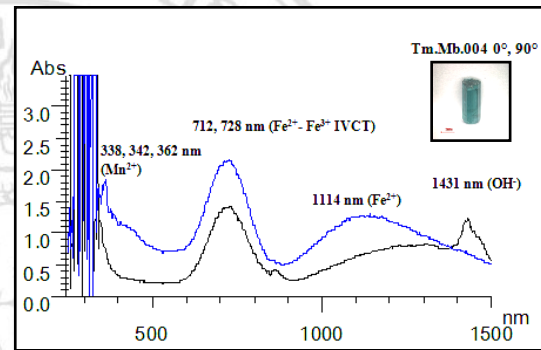
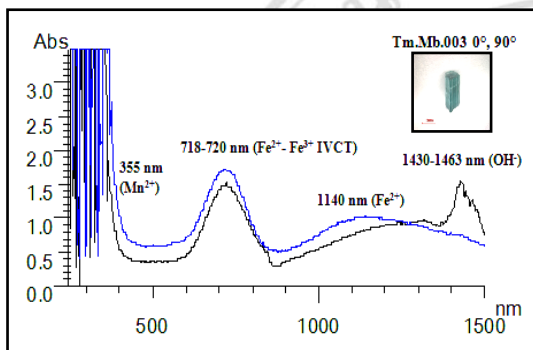
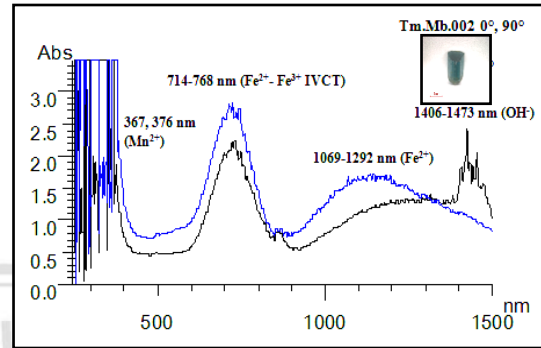
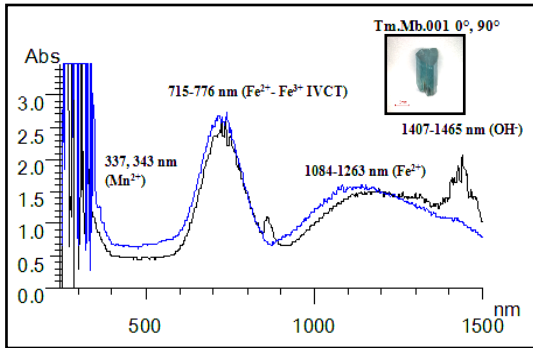


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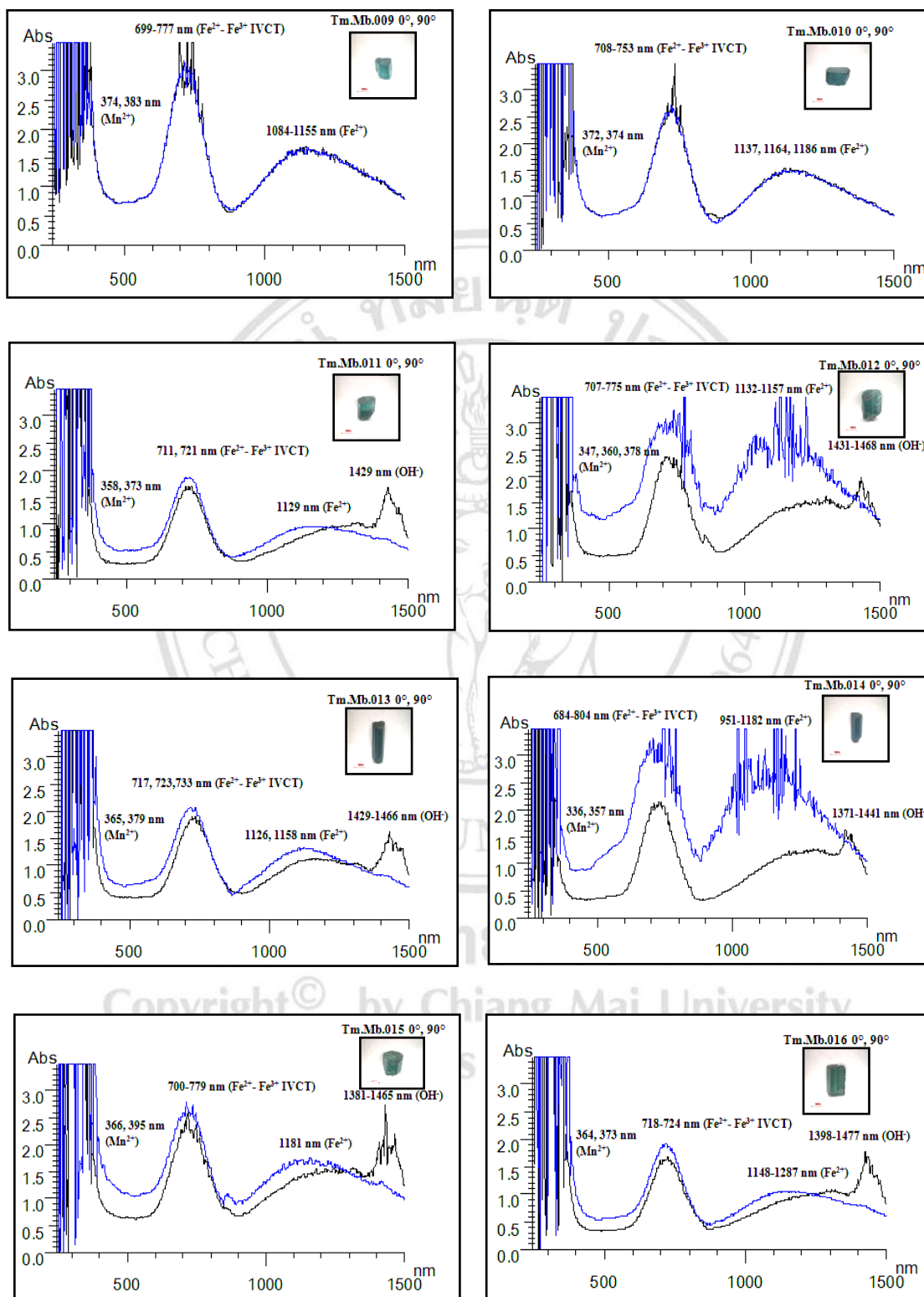


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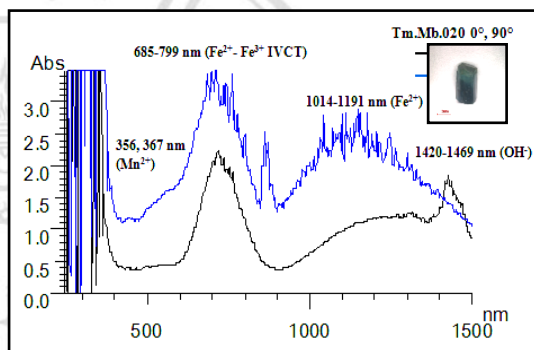
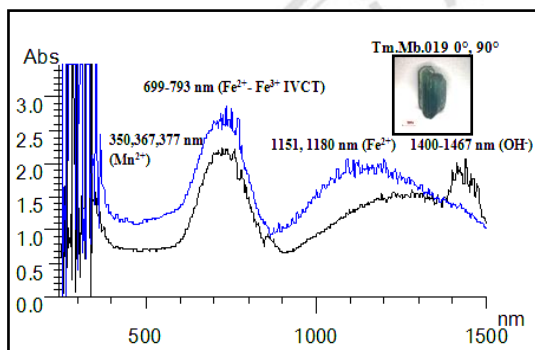
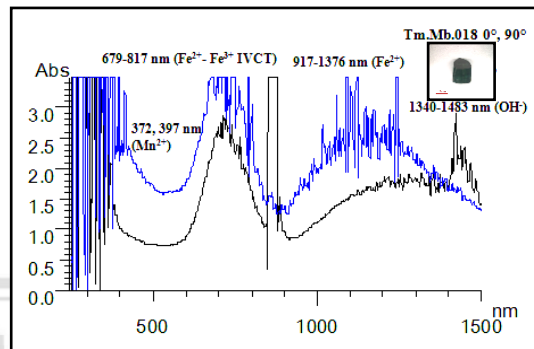
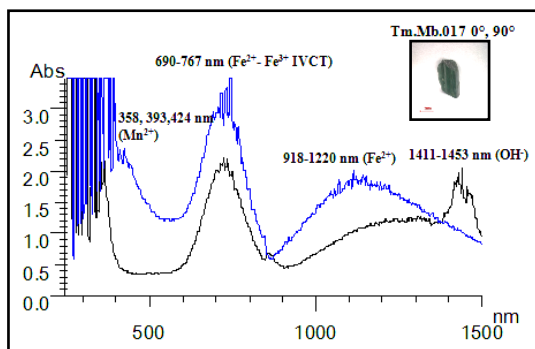
UV-Vis-NIR absorption spectra of green tourmalines from Mozambique



Appendix A (continued).

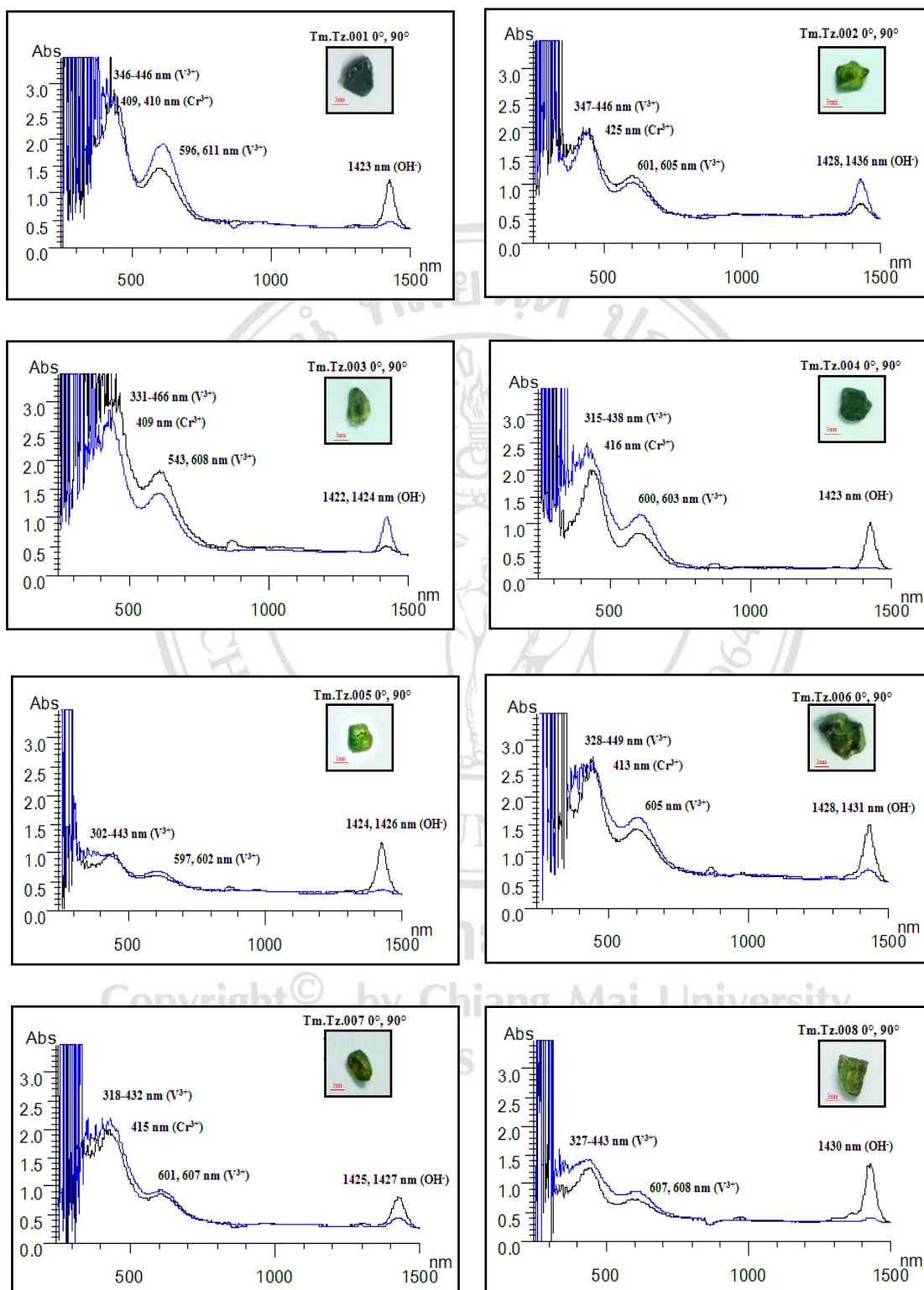


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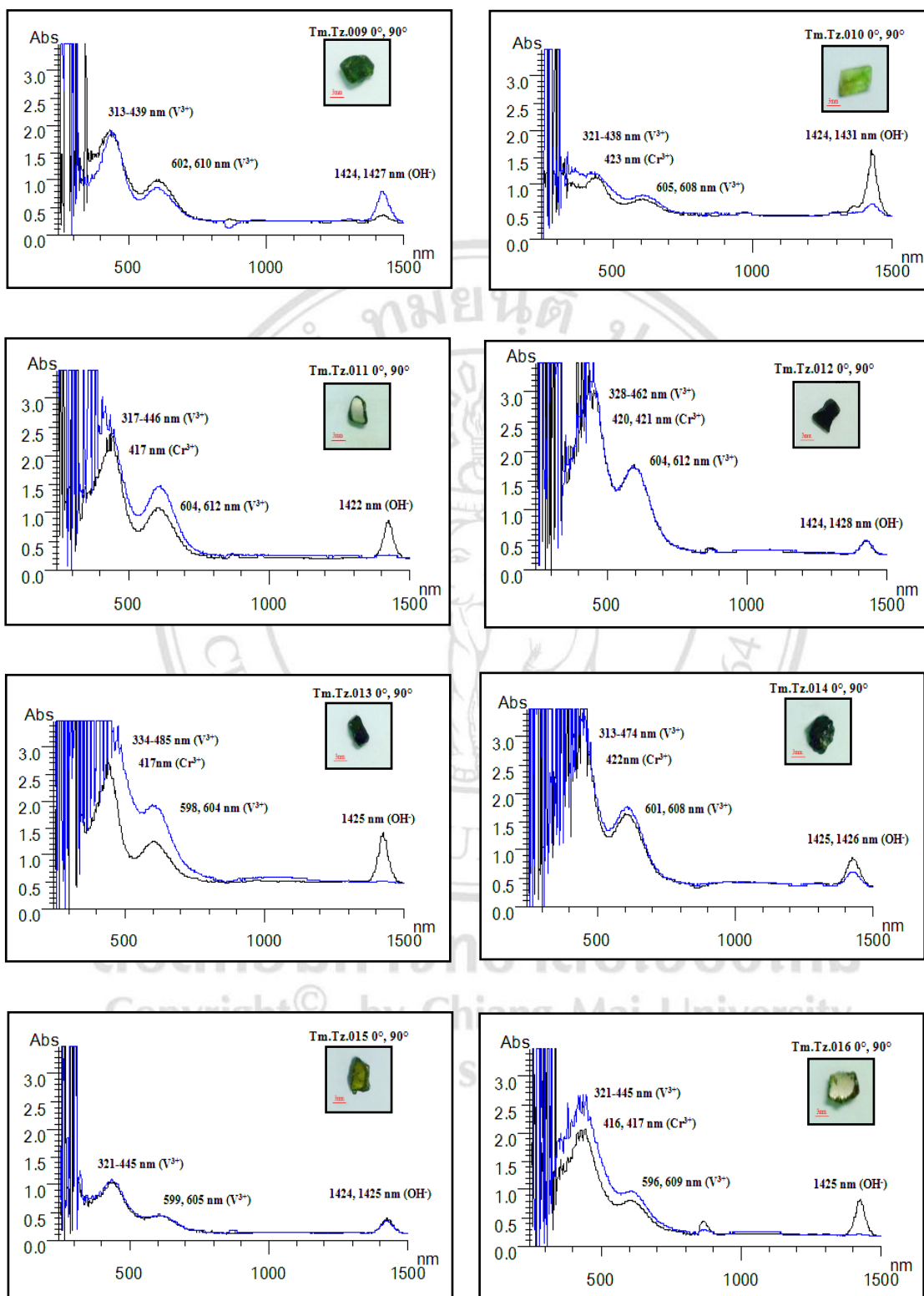


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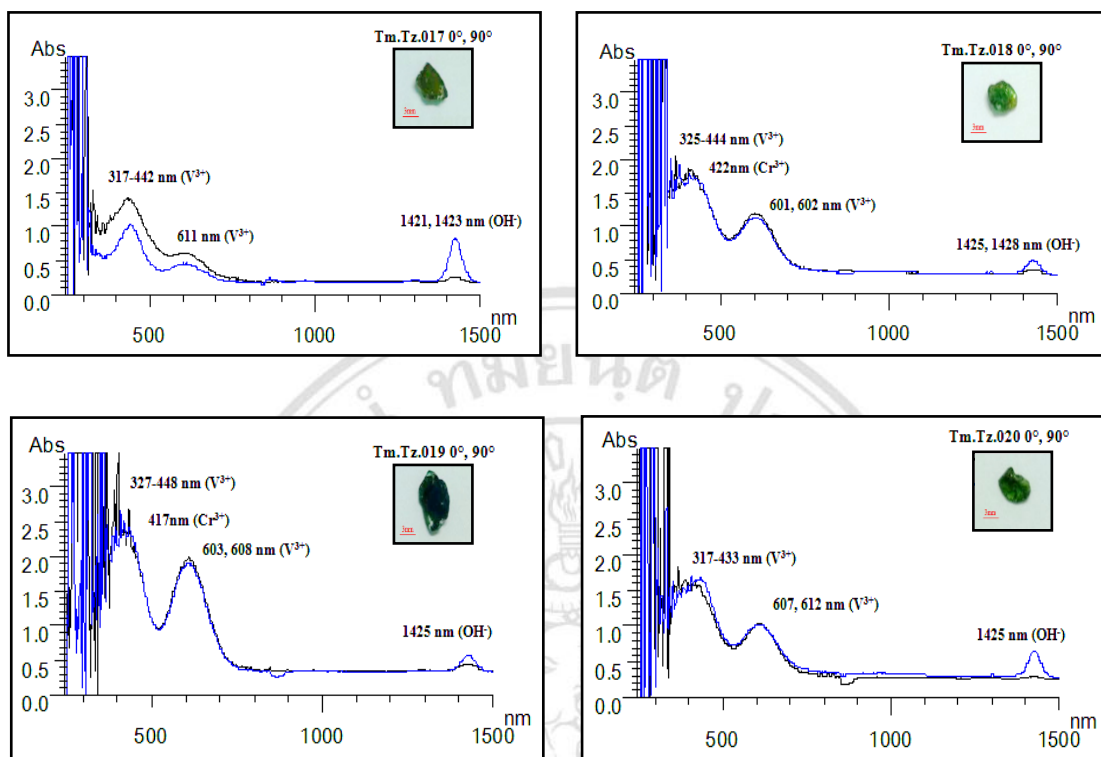
UV-Vis-NIR absorption spectra of green tourmalines from Tanzania



Appendix A (continued).



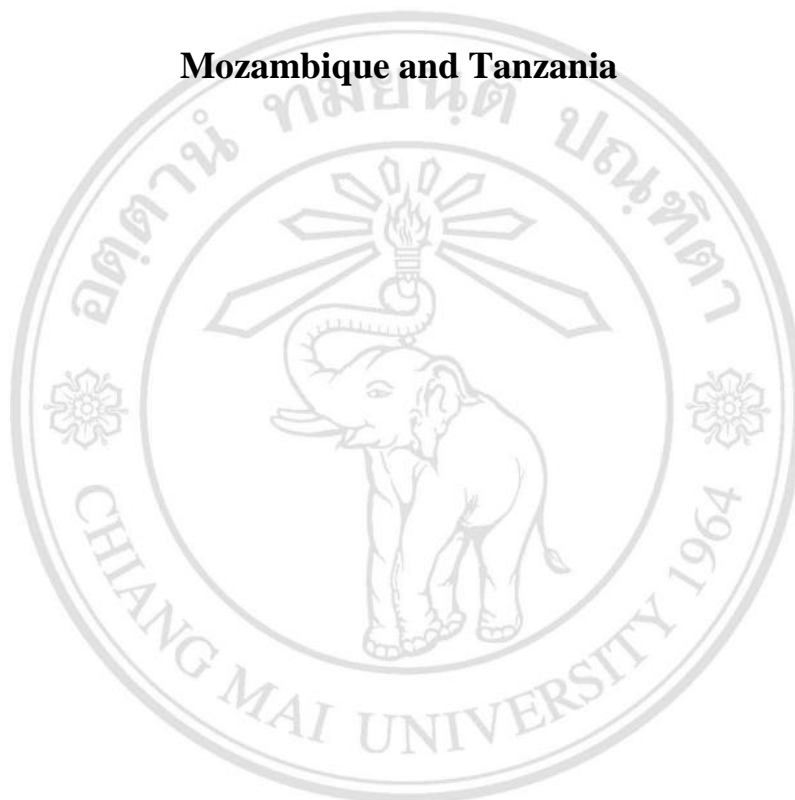
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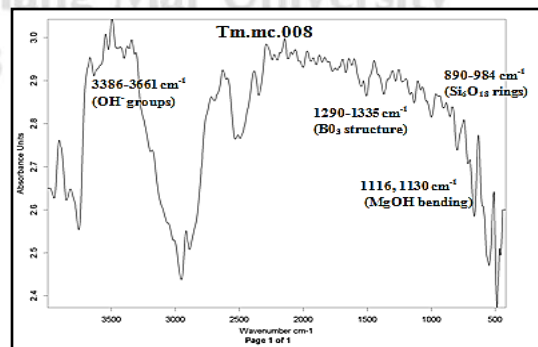
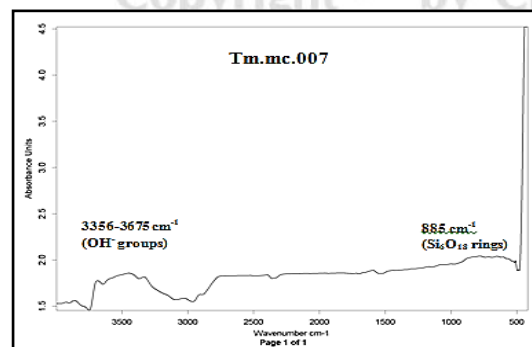
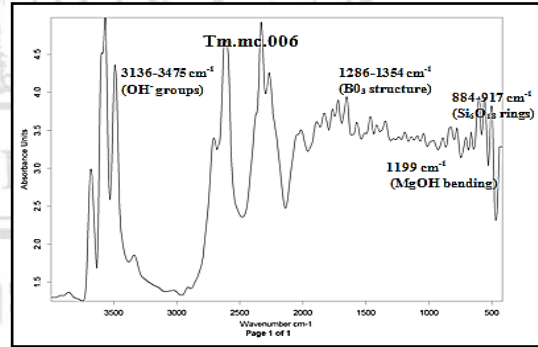
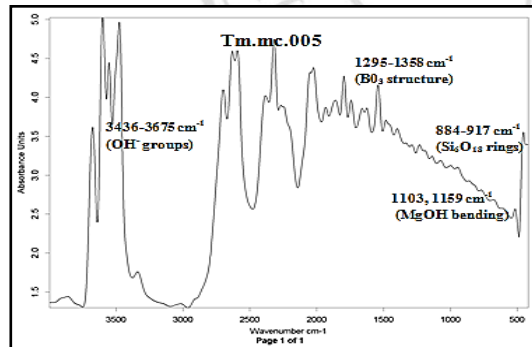
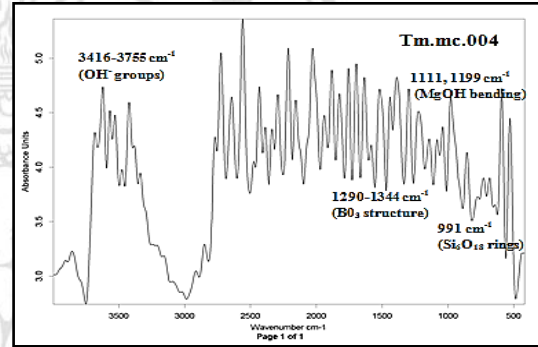
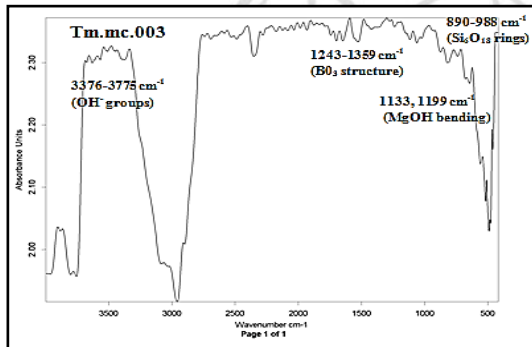
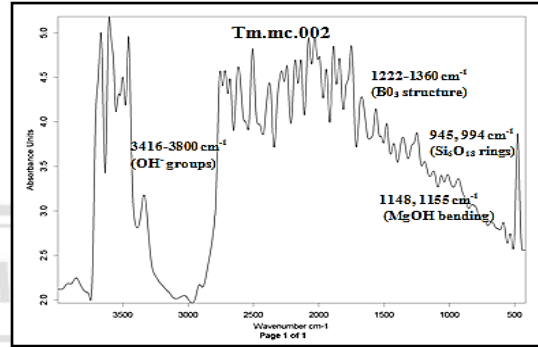
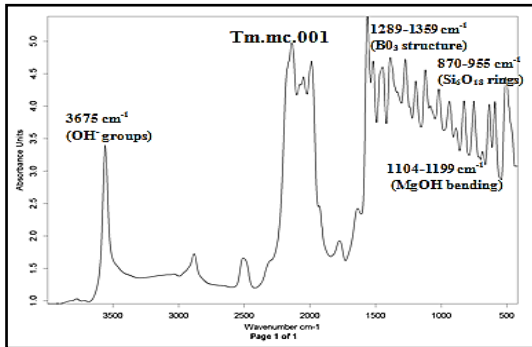
APPENDIX B

**FTIR absorption spectra of green tourmaline from Madagascar,
Mozambique and Tanzania**

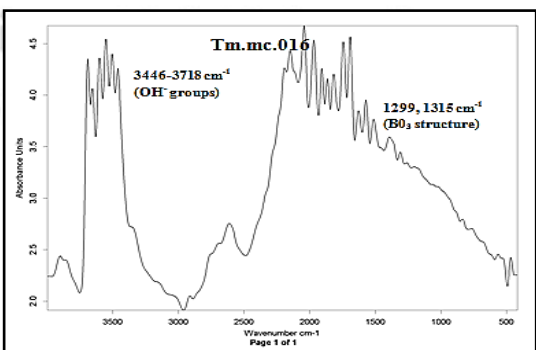
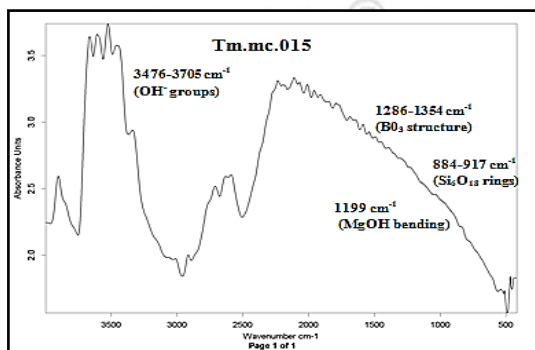
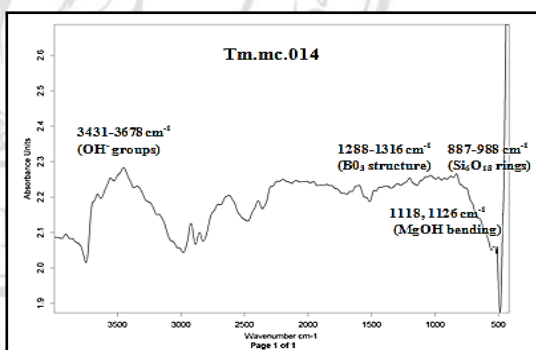
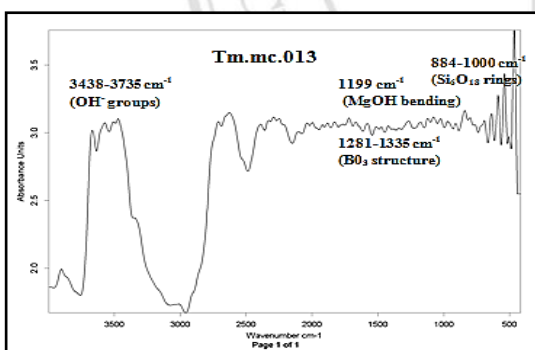
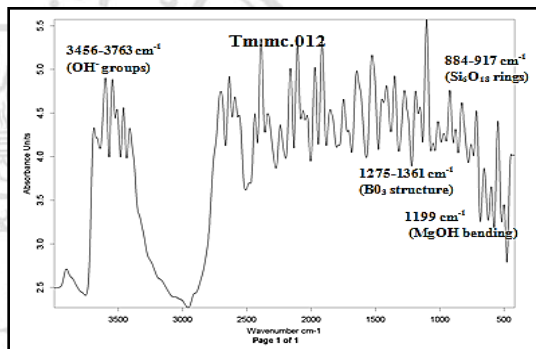
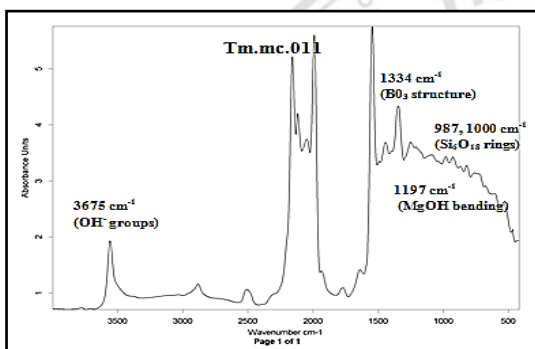
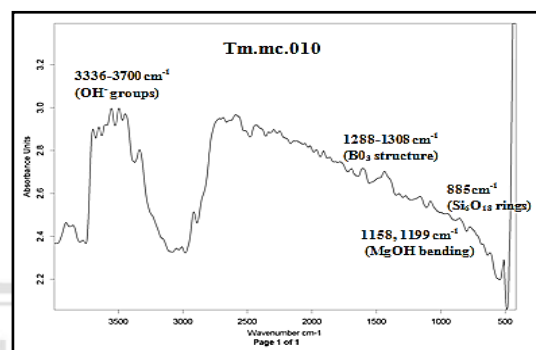
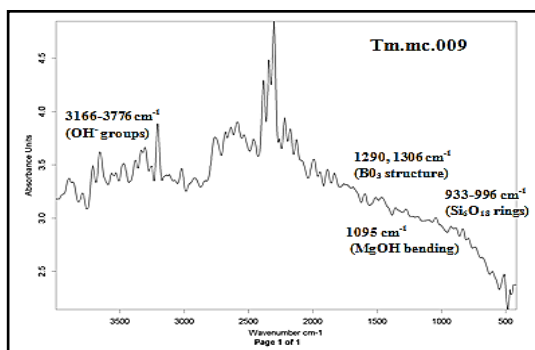


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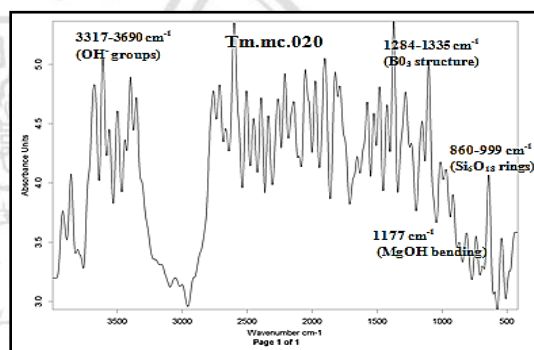
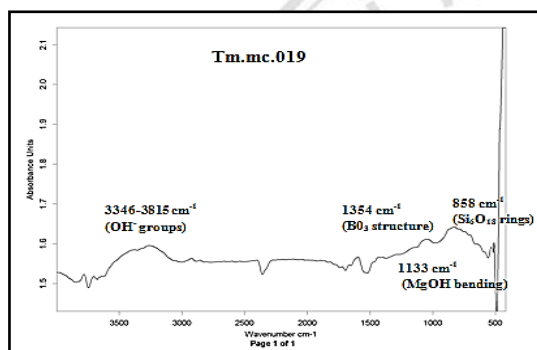
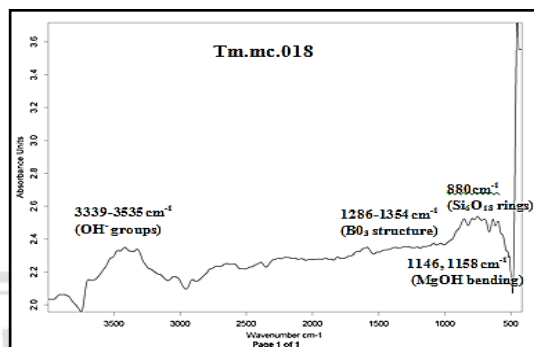
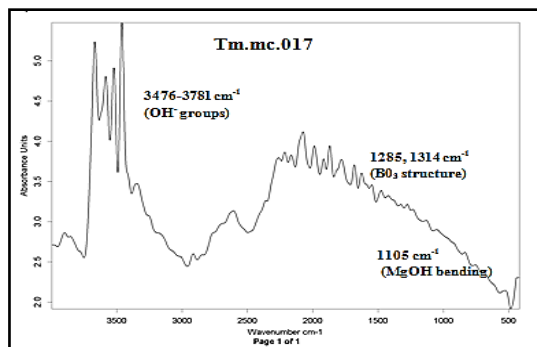
Appendix B FTIR absorption spectra of green tourmaline from Madagascar



Appendix B (continued).

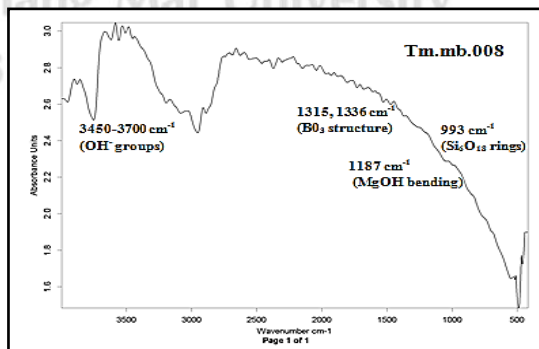
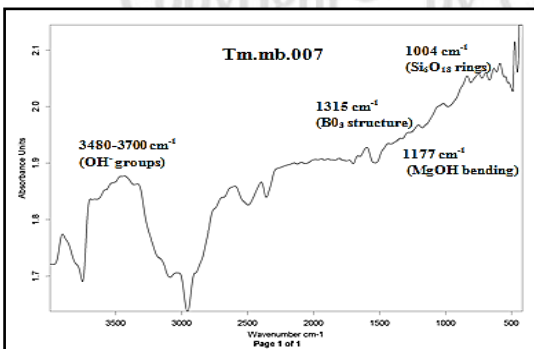
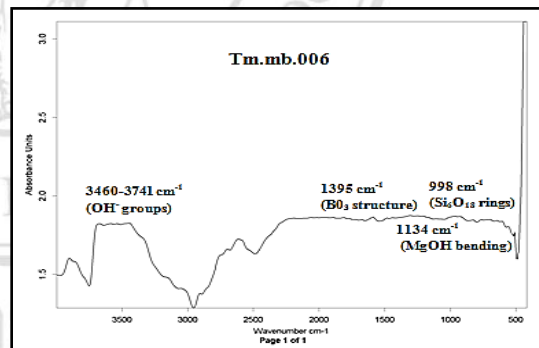
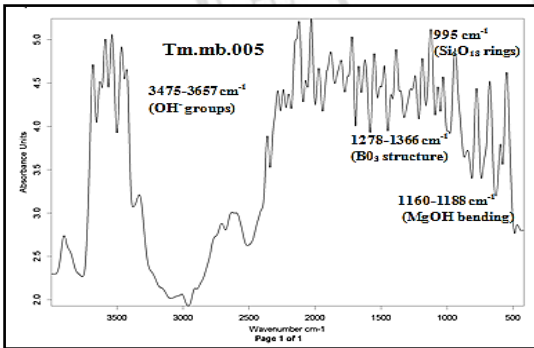
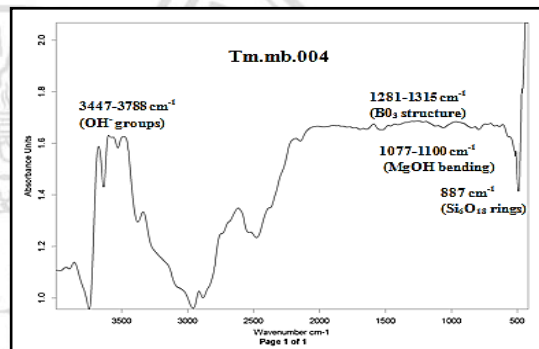
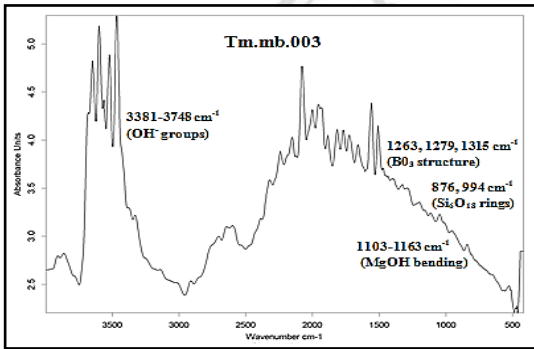
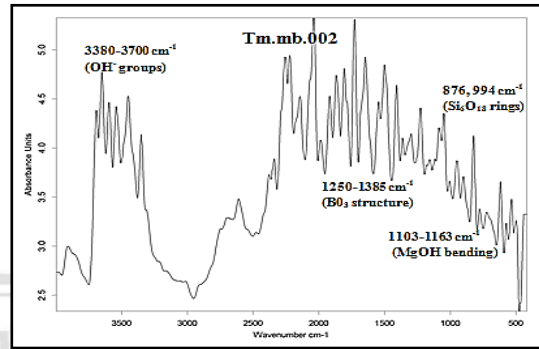
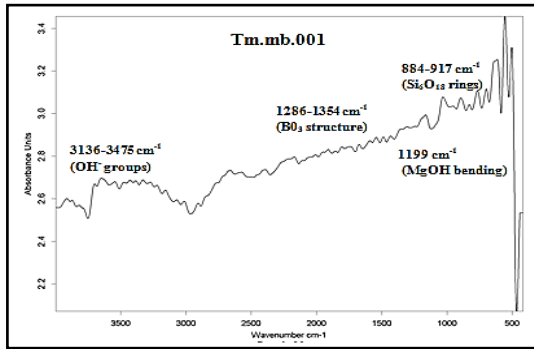


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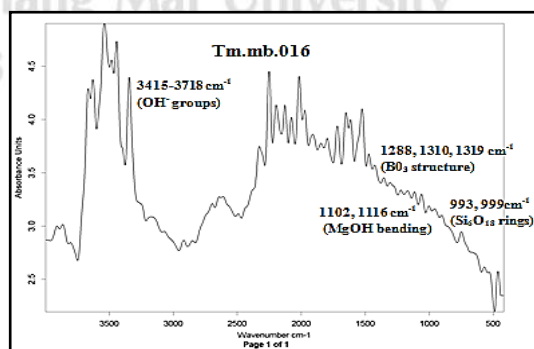
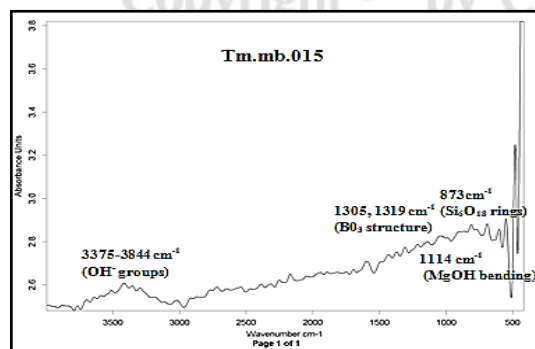
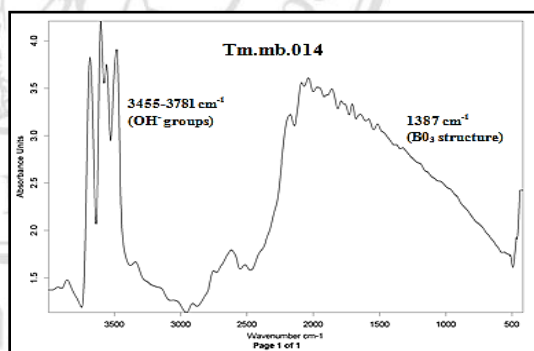
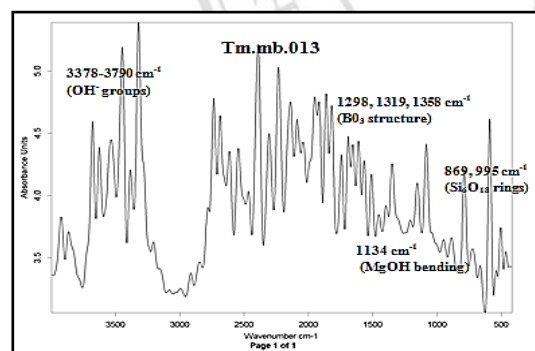
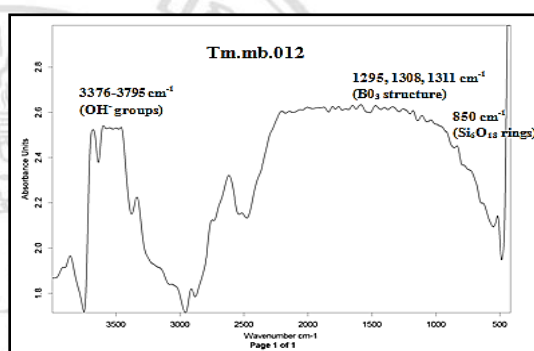
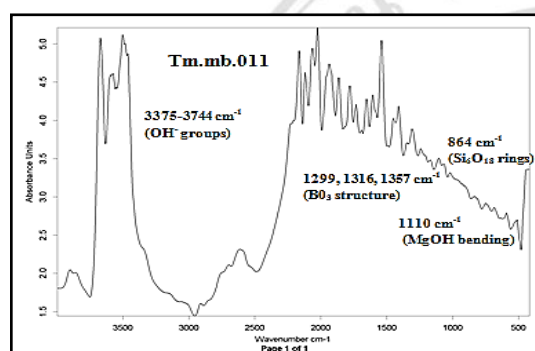
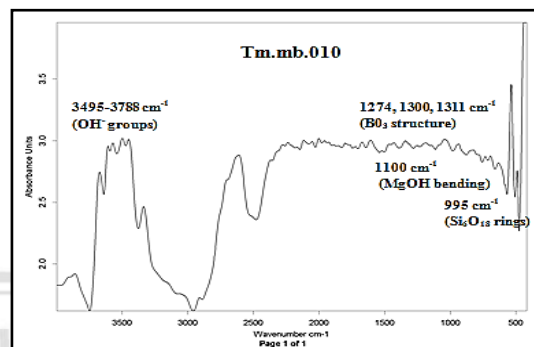
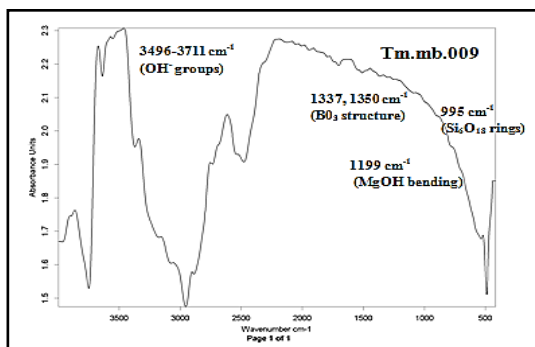


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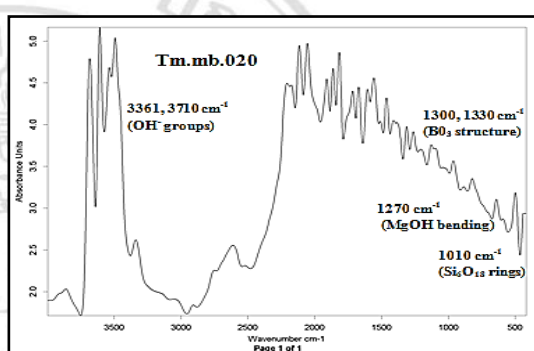
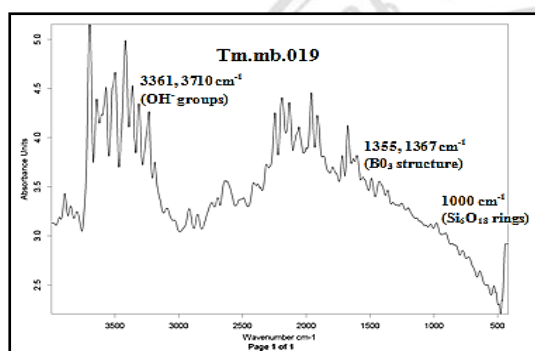
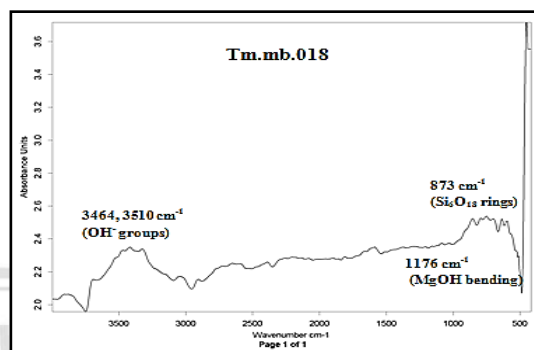
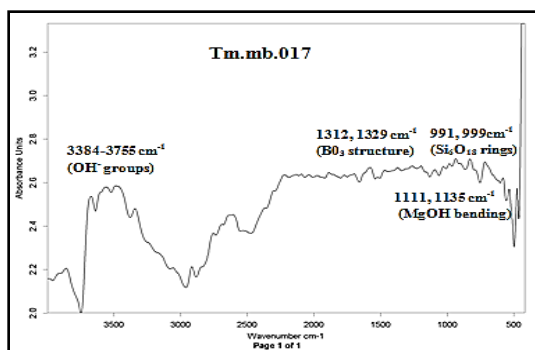
FTIR absorption spectra of green tourmaline from Mozambique



Appendix B (continued).

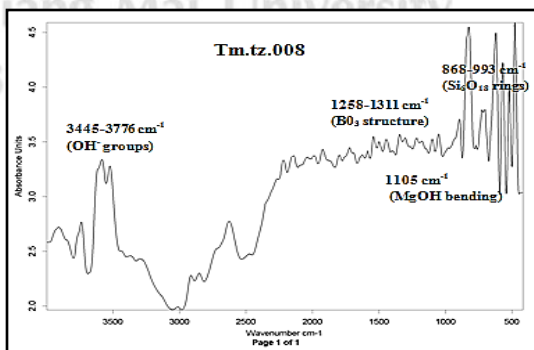
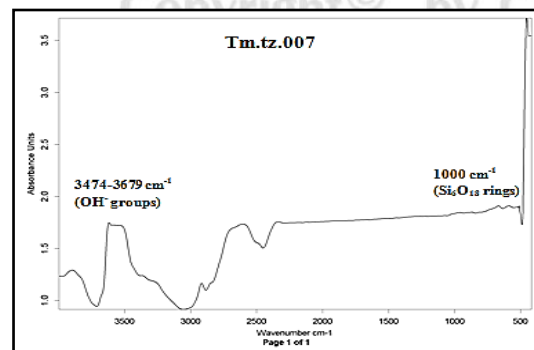
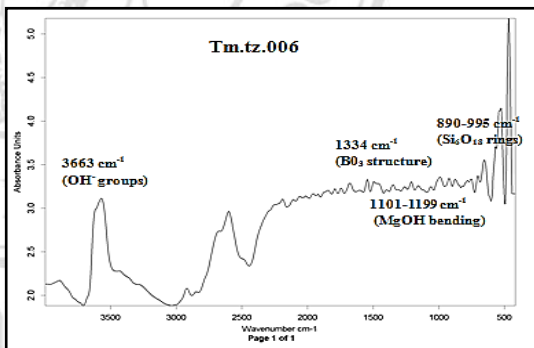
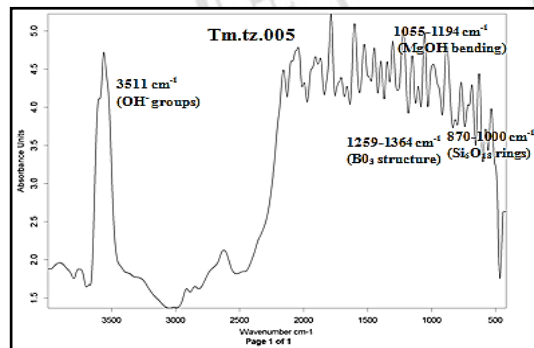
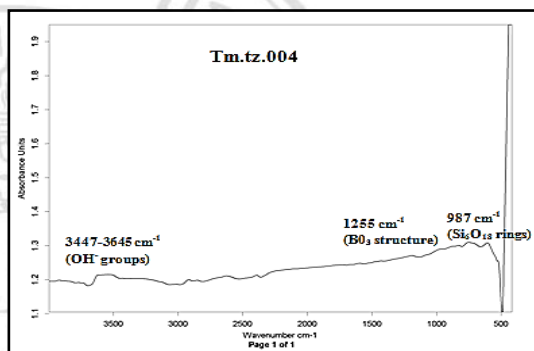
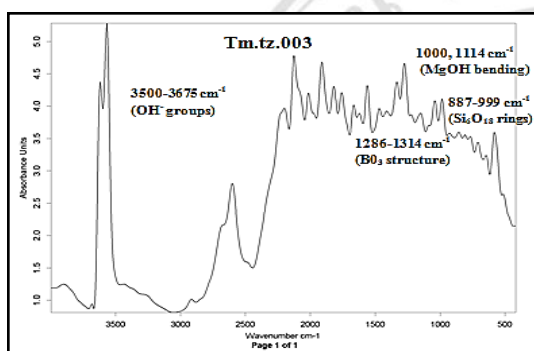
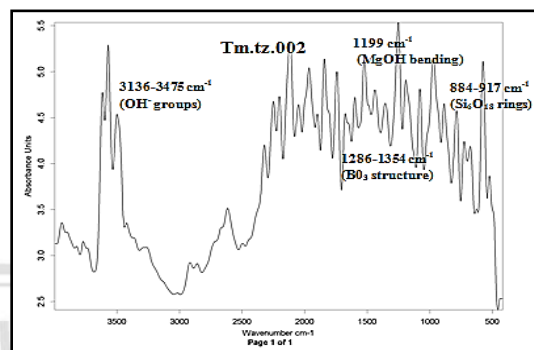
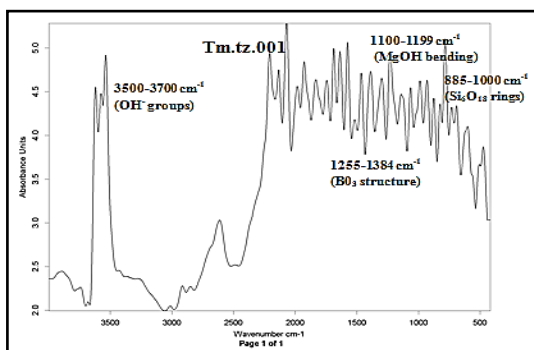


Appendix B (continued).

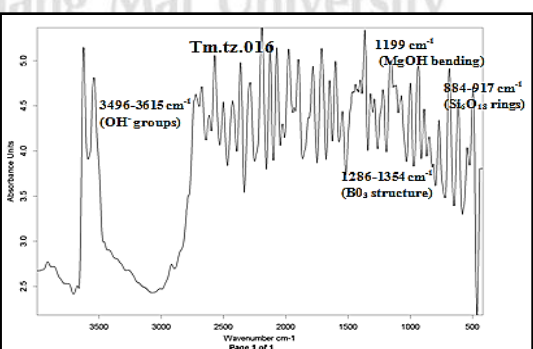
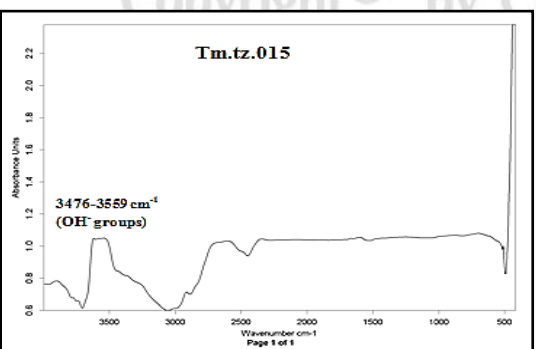
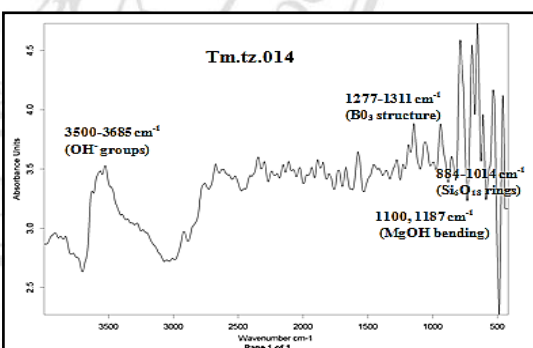
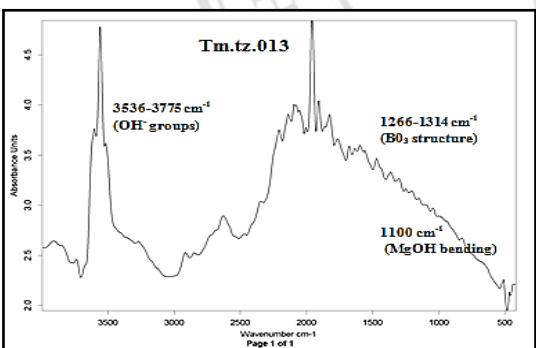
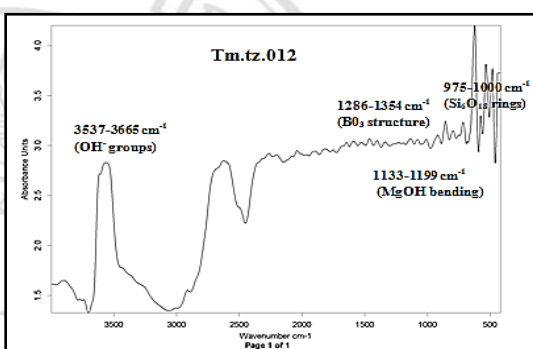
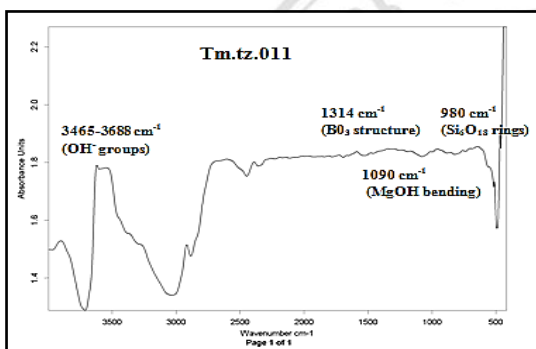
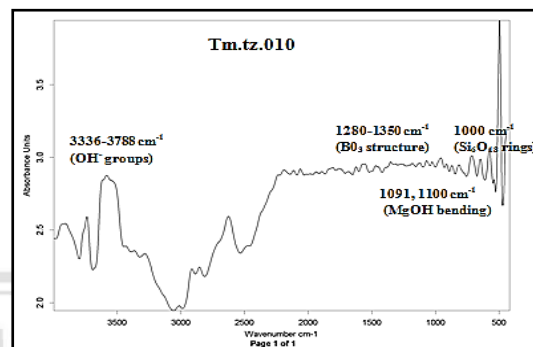
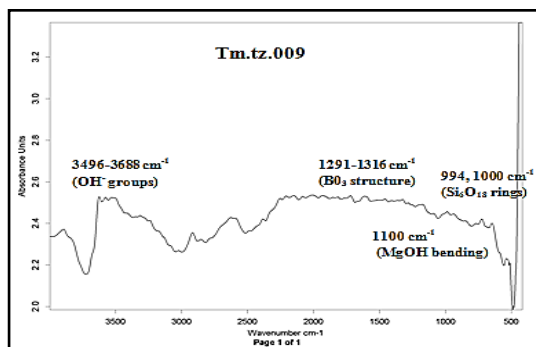


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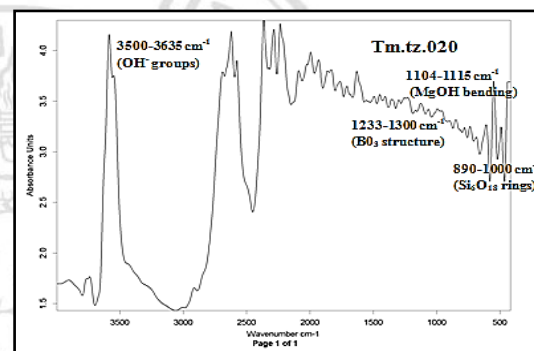
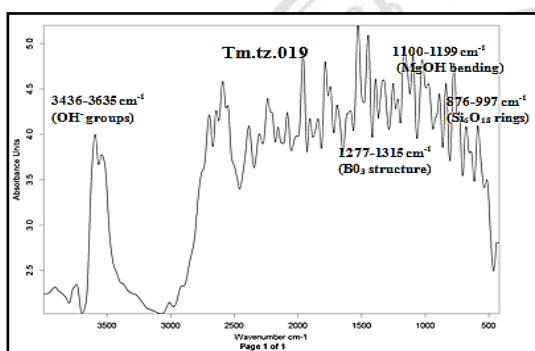
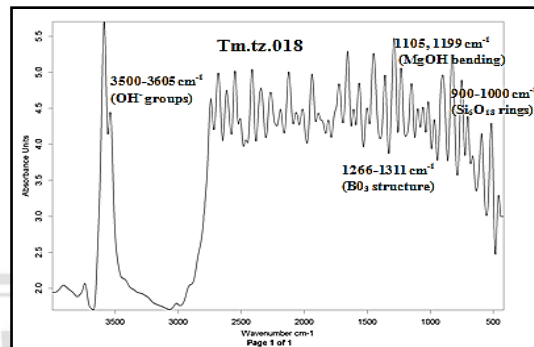
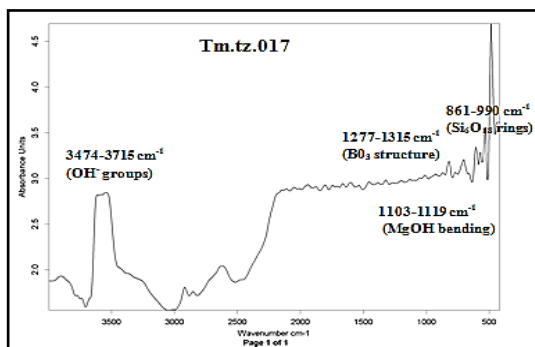
FTIR absorption spectra of green tourmaline from Tanzania



Appendix B (continued).



Appendix B (continued).



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APPENDIX C




**Chemical analyses of three random locations of green tourmaline samples
from Madagascar, Mozambique and Tanzania using EPMA-WDS**







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APPENDIX C

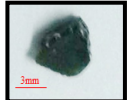
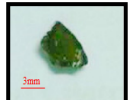
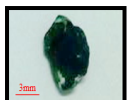
Chemical analyses three random locations of green tourmaline samples from Madagascar using EPMA-WDS

Sample no.	Points	Weight% oxide																	Total 100%
		Al ₂ O ₃	SiO ₂	V ₂ O ₃	MnO	TiO ₂	F	B ₂ O ₃	Cr ₂ O ₃	FeO	CaO	MgO	Na ₂ O	CuO	K ₂ O	Li ₂ O calc.	H ₂ O calc.	O=F	
Tm.Mc.005 	#1	40.40	36.99	0.01	1.83	0.01	0.62	10.85	0.02	2.49	0.31	0	2.18	0	0.03	1.56	3.49	-0.26	100.53
	#2	40.64	36.41	0	1.53	0	0.55	10.93	0	3.23	0.39	0.02	2.26	0	0.02	1.54	3.52	-0.23	100.81
	#3	40.35	36.12	0	1.66	0	0.68	11.02	0	3.57	0.36	0	2.36	0	0.02	1.55	3.45	-0.29	100.85
Tm.Mc.012 	#1	40.68	36.89	0.01	0.40	0	0.60	11.03	0	3.03	0.76	0.04	2.05	0	0.02	1.79	3.51	-0.25	100.56
	#2	40.70	36.98	0	0.32	0.01	0.58	10.97	0.02	2.99	0.71	0.05	2.02	0.02	0.02	1.78	3.52	-0.24	100.45
	#3	40.04	36.12	0	0.54	0.02	0.72	11.10	0	3.26	0.72	0.05	1.99	0.01	0.02	1.80	3.41	-0.30	99.50
Tm.Mc.015 	#1	40.15	37.04	0.02	1.14	0.01	0.53	11.00	0.01	3.51	0.40	0.06	1.87	0.02	0.01	1.55	3.53	-0.22	100.61
	#2	40.10	38.67	0	1.05	0	0.47	10.61	0	3.25	0.17	0.09	1.84	0.02	0.02	1.56	3.59	-0.20	101.24
	#3	40.40	38.35	0	1.17	0.01	0.58	10.73	0	3.02	0.45	0.1	1.75	0.02	0.02	1.51	3.55	-0.24	101.42

Chemical analyses three random locations of green tourmaline samples from Mozambique using EPMA-WDS

Sample no.	Points	Weight% oxide																	Total 100%
		Al ₂ O ₃	SiO ₂	V ₂ O ₃	MnO	TiO ₂	F	B ₂ O ₃	Cr ₂ O ₃	FeO	CaO	MgO	Na ₂ O	CuO	K ₂ O	Li ₂ O calc.	H ₂ O calc.	O=F	
Tm.Mb.007 	#1	40.49	36.88	0	0.87	0.01	0.60	10.33	0	3.07	0.25	0	2.22	0	0	1.37	3.45	-0.25	99.29
	#2	40.68	37.16	0	0.10	0	0.60	10.55	0.02	3.00	0.26	0	2.19	0	0.01	1.56	3.47	-0.25	99.35
	#3	40.93	35.14	0.01	1.26	0.01	0.76	10.52	0	3.18	0.27	0	2.40	0.03	0.01	1.36	3.34	-0.32	98.90
Tm.Mb.013 	#1	40.63	37.44	0.02	0.74	0.01	0.49	11.47	0.01	2.34	0.45	0.01	1.94	0	0	1.97	3.60	-0.21	100.91
	#2	40.76	37.30	0	0.90	0	0.49	10.11	0.03	2.36	0.42	0	1.92	0	0.01	1.32	3.50	-0.21	98.91
	#3	40.70	37.93	0	0.82	0	0.48	11.28	0	2.51	0.37	0	1.98	0.01	0.02	1.85	3.62	-0.20	101.37
Tm.Mb.018 	#1	40.43	35.74	0	0.94	0	0.52	10.66	0.04	4.05	0.20	0.04	2.31	0	0.03	1.36	3.48	-0.22	99.58
	#2	40.98	37.14	0.02	0.92	0.01	0.60	10.24	0	3.50	0.30	0.02	2.19	0.04	0.02	1.22	3.48	-0.25	100.43
	#3	40.26	36.12	0	0.99	0.01	0.52	11.14	0	3.74	0.23	0.06	2.17	0	0.02	1.61	3.52	-0.22	100.16
Tm.Mb.020 	#1	40.61	35.01	0.02	1.74	0	0.62	11.23	0.02	3.39	0.39	0.03	2.37	0	0.02	1.62	3.45	-0.26	100.26
	#2	40.33	36.19	0	2.20	0	0.54	10.84	0	2.22	0.57	0.01	2.08	0.03	0.02	1.57	3.49	-0.23	99.86
	#3	40.87	35.41	0.02	0.86	0.02	0.55	11.51	0	3.38	0.24	0.03	2.38	0.02	0.02	1.42	3.45	-0.23	99.95

Chemical analyses three random locations of green tourmaline samples from Tanzania using EPMA-WDS

Sample no.	Points	Weight% oxide																	Total 100%
		Al ₂ O ₃	SiO ₂	V ₂ O ₃	MnO	TiO ₂	F	B ₂ O ₃	Cr ₂ O ₃	FeO	CaO	MgO	Na ₂ O	CuO	K ₂ O	Li ₂ O calc.	H ₂ O calc.	O=F	
Tm.Tz.011 	#1	26.89	38.63	0.19	0.02	0.12	0.46	10.31	0.07	0	3.91	13.43	1.17	0.04	0.02	0.91	3.48	-0.19	99.46
	#2	27.26	38.65	0.20	0.01	0.12	0.60	11.04	0.09	0.02	3.70	13.54	1.26	0	0.04	0.97	3.47	-0.25	100.49
	#3	27.15	38.96	0.20	0.02	0.12	0.53	10.42	0.07	0.01	3.74	13.20	1.24	0	0.03	1.09	3.51	-0.22	100.07
Tm.Tz.017 	#1	27.18	38.23	0.19	0.01	0.12	0.54	10.57	0.08	0.03	4.64	13.36	0.88	0	0.03	0.89	3.47	-0.23	99.98
	#2	27.24	38.09	0.18	0	0.10	0.53	10.63	0.07	0	4.52	13.10	0.95	0.01	0.02	0.98	3.46	-0.22	99.66
	#3	27.00	38.30	0.18	0.01	0.11	0.54	11.19	0.06	0	4.50	13.70	0.91	0	0.04	1.00	3.50	-0.23	100.81
Tm.Tz.019 	#1	27.06	38.64	0.24	0	0.20	0.19	10.84	0.12	0	3.58	12.99	1.17	0	0.08	1.10	3.64	-0.08	99.77
	#2	27.50	38.67	0.25	0	0.15	0.14	10.96	0.10	0	3.61	12.34	1.22	0	0.06	1.26	3.67	-0.06	99.87
	#3	27.19	38.58	0.25	0	0.20	0.15	10.85	0.09	0	3.76	12.12	1.16	0.02	0.07	1.32	3.65	-0.06	99.33

APPENDIX D




**Chemical analyses of three random locations of green tourmaline
samples from Madagascar, Mozambique and Tanzania
using LA-ICP-MS**






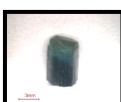
ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่
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APPENDIX D

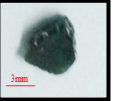

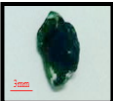
Chemical analyses of three random locations of green tourmaline samples from Madagascar using LA-ICP-MS

Sample no.	Points	Trace element (ppm)																		
		Li	Be	Sc	Ti	V	Cr	Fe	Ni	Zn	Ga	Ge	Sr	Nb	Mo	Sn	Sb	Ta	Pb	Bi
Tm.Mc.005 	#1	1443.86	2.53	8.14	18.67	0.60	5.82	58038.31	2.68	80.32	13.94	3.29	2.39	0.49	1.83	31.3	1.25	1.05	55.72	0.47
	#2	1424.74	2.61	8.42	14.96	0.43	5.98	55462.63	2.12	77.89	14.94	3.59	2.42	0.49	1.70	26.89	1.06	0.51	58.34	0.66
	#3	1463.42	2.63	7.64	11.97	0.64	5.76	50906.26	3.14	76.06	14.05	3.51	1.81	0.42	2.17	29.9	0.99	0.87	57.14	0.69
Tm.Mc.012 	#1	1619.23	3.52	8.74	29.05	0.68	7.49	46845.53	2.97	150.87	28.78	5.83	4.55	1.09	2.74	9.12	4.06	0.88	44.39	15.98
	#2	1657.51	2.07	7.76	42.89	0.43	6.63	50247.33	3.33	131.78	26.39	6.15	3.68	1.39	1.81	10.11	3.32	1.19	40.92	13.35
	#3	1674.82	2.7	8.16	38.49	0.53	7.37	43487	3.70	136.59	23.97	7.91	3.57	0.82	1.74	10.28	3.81	1.20	45.75	11.77
Tm.Mc.015 	#1	1722.44	6.95	8.07	52.25	1.28	16.20	283.54	6.01	29.32	58.80	9.18	0.72	0.76	5.06	8.23	3.21	0.75	5.76	71.76
	#2	1655.42	4.06	8.11	86.57	0.77	11.20	947.59	4.59	140.64	69.08	5.81	0.55	0.42	3.13	5.52	2.41	0.53	3.80	37.3
	#3	1446.3	9.41	7.48	28.60	2.01	26.85	538.98	12.32	48.17	59.63	15.35	1.40	1.20	4.92	9.79	4.21	1.49	8.15	10.09

Chemical analyses of three random locations of green tourmaline samples from Mozambique using LA-ICP-MS

Sample no.	Points	Trace element (ppm)																		
		Li	Be	Sc	Ti	V	Cr	Fe	Ni	Zn	Ga	Ge	Sr	Nb	Mo	Sn	Sb	Ta	Pb	Bi
 Tm.Mb.007	#1	1304.49	6.74	7.54	7.92	0.56	6.86	34647.56	4.52	667.13	12.20	10.21	6.29	0.40	2.45	16.30	1.29	1.42	31.81	0.67
	#2	1407.8	2.48	6.66	4.95	0.53	5.99	40170.15	3.10	706.87	11.52	11.26	9.43	0.36	2.26	15.01	0.88	0.39	56.08	0.71
	#3	1569.61	3.37	8.71	7.10	0.74	7.56	50553.68	3.69	634.89	9.93	4.92	65.88	0.48	2.69	6.79	2.08	3.01	169.11	0.89
 Tm.Mb.013	#1	1428.11	3.58	6.73	8.45	0.78	8.34	29299.94	4.33	97.64	12.35	5.39	0.56	0.49	2.95	22.14	2.61	0.58	14.72	1.20
	#2	1451.21	4.66	7.01	8.85	0.58	9.81	26596.32	4.94	128.08	13.66	5.61	0.91	0.41	2.54	21.22	1.88	0.62	11.72	0.97
	#3	1392.45	3.78	7.71	13.62	0.48	7.20	56195.93	3.24	204.39	13.17	3.65	2.28	0.40	2.47	4.19	1.00	1.25	54.22	0.85
 Tm.Mb.018	#1	1311.89	2.95	6.72	29.39	0.73	6.34	38772	3.54	254.65	19.68	4.56	0.33	0.41	1.82	16.46	1.50	0.42	10.99	0.69
	#2	1323.12	3.64	6.34	29.40	0.53	5.99	39337.14	3.90	239.83	19.44	9.34	0.43	0.39	1.79	16.79	1.48	0.40	10.38	0.68
	#3	1277.61	3.42	6.36	25.11	0.69	7.10	39368.41	3.14	258.77	18.40	9.92	0.32	0.53	2.28	13.52	1.53	0.45	9.52	1.02
 Tm.Mb.020	#1	1298.98	2.68	7.21	7.95	0.43	5.88	60992.37	2.30	73.09	10.30	3.25	0.70	0.24	1.80	12.08	1.37	0.37	1.56	0.45
	#2	1940.82	3.23	6.51	8.17	0.63	7.69	20110.52	2.67	51.41	8.43	4.05	1.23	0.37	1.51	25.88	1.54	0.41	2.13	0.87
	#3	1413.09	2.98	6.23	7.20	0.63	8.04	14608.56	2.96	32.17	10.24	6.19	1.14	0.54	3.23	29.18	1.44	0.39	2.27	0.70

Chemical analyses of three random locations of green tourmaline samples from Tanzania using LA-ICP-MS

Sample no.	Points	Trace element (ppm)																		
		Li	Be	Sc	Ti	V	Cr	Fe	Ni	Zn	Ga	Ge	Sr	Nb	Mo	Sn	Sb	Ta	Pb	Bi
Tm.Tz.001 	#1	12.98	2.34	6.19	607.27	645.25	249.92	28.56	2.31	6.29	0.84	3.27	92.18	0.32	1.56	1.63	1.12	0.39	1.01	0.63
	#2	13.74	3.67	6.66	627.46	556.94	190.77	35.76	3.67	8.61	1.39	4.17	96.96	0.30	2.50	2.42	1.41	0.29	1.81	0.94
	#3	12.42	3.18	6.42	659.72	545.36	200.26	37.91	3.81	7.78	1.38	4.26	111.35	0.31	1.81	2.24	1.97	0.46	1.27	0.78
Tm.Tz.017 	#1	5.51	5.42	5.62	565.49	174.09	16.82	60.29	6.41	12.93	4.85	8.57	196.73	0.75	2.85	3.51	1.55	0.72	2.44	2.04
	#2	4.05	6.13	5.40	555.03	170.72	18.21	66.30	8.42	17.55	2.91	8.33	201.05	0.78	4.00	4.93	3.26	0.82	3.68	1.49
	#3	5.49	6.58	4.80	554.07	183.30	18.04	83.35	9.97	18.15	3.50	10.36	209.15	0.85	6.74	5.79	4.80	0.94	3.55	2.31
Tm.Tz.019 	#1	6.39	2.26	6.11	690.10	552.47	492.66	25.69	3.27	5.41	6.79	2.99	64.76	0.33	2.37	2.02	1.48	0.37	1.34	0.66
	#2	6.68	2.13	6.66	721.18	543.26	476.27	27.82	2.12	3.97	7.19	3.88	65.88	0.28	2.18	2.19	1.56	0.39	1.50	0.66
	#3	6.44	2.55	6.66	713.82	483.92	361.03	28.19	3.70	6.07	6.81	2.61	68.16	0.26	2.37	2.10	0.84	0.32	1.99	0.74

CURRICULUM VITAE

Name	Ms. Maytinee Kaewtip
Date of Birth	June 24, 1988
Education	2010, B.Sc. (Gemology), Chiang Mai University
Scholarship	Teaching Assistant of Department of Geological Sciences, Faculty of Science, Chiang Mai University (2012-2014)
Honors/Awards	The best student academic year end of Department of Geological Sciences, Faculty of Science, Chiang Mai University, 2009 (GPA: 3.80)
Job Training experience	Student Trainee worked at P. Collection Ltd. about colored stones grading from 15 March to 15 May 2010
Activity	Staff technical workshops in 2 nd Asia-Pacific water summit 16-18 may 2013

Publications and Presentations

Kaewtip, M. and Limtrakun, P., 2014, Gemological Characteristics of Green Tourmaline from Madagascar, Mozambique and Tanzania, Proceedings: International Graduate Research Conference 2014, The Empress Convention Centre Chiang Mai, Chiang Mai, Thailand, December 12, 2014, pp. ST 21-25.

