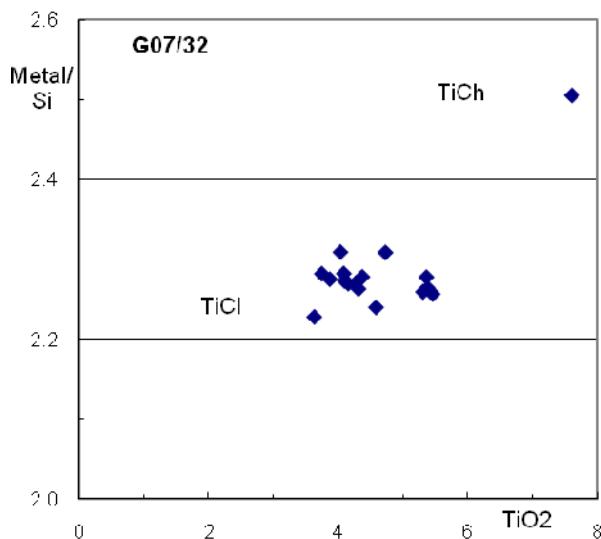


**Dunites from Isua, southern West Greenland: a ~3720 Ma window into sub-crustal metasomatism of depleted mantle.**

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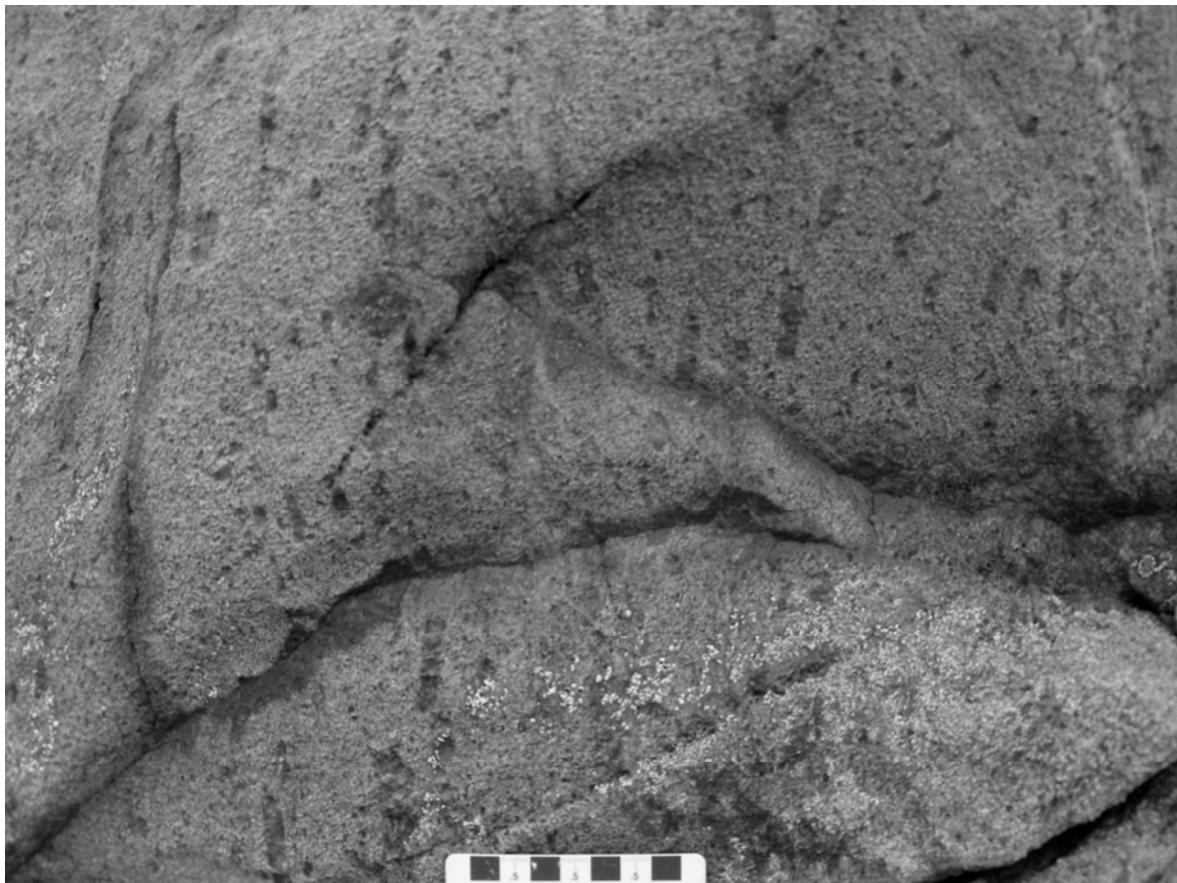
**Figure DR1.**

Representative plot of  $\text{TiO}_2$  vs Metal/Si to illustrate the separation between Titanian Clinohumite (TiCl) and Titanian Chondrodite (TiCh). Representative data are given in Table DR2.



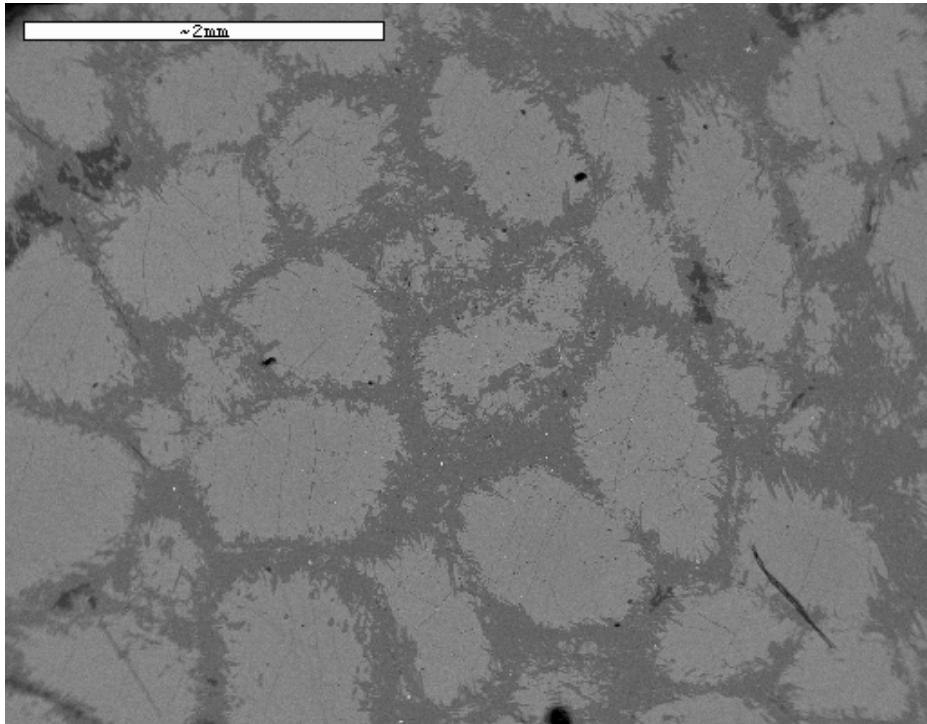
**Figure DR2.**

Field photograph of part of one of the little altered dunite lenses. The larger elongate olivine crystals are set in a finer grained matrix. Zones of dunite with these oriented crystals are interspersed with zones devoid of them.



**Figure DR3.**

Example BSE image of a polished section of the little altered dunite sample G07/10 showing the distribution of olivine and the largely chlorite -talc alteration along the grain boundaries.



**Table DR1.** Major and trace element geochemistry of the ultramafic rocks.

Sample No	Body A	Body B
	G07/10	G07/32
rock type	dunite	dunite
SHRIMP age	3720	3720
Loc N	65 08.383	65 09.256
Loc W	50 09.014	50 08.704
SiO <sub>2</sub>	39.90	38.63
TiO <sub>2</sub>	0.055	0.032
Al <sub>2</sub> O <sub>3</sub>	0.715	0.509
Fe <sub>2</sub> O <sub>3</sub> *	8.115	6.743
MnO	0.113	0.11
MgO	46.378	44.578
CaO	0.079	nd
Na <sub>2</sub> O	0.067	0.061
K <sub>2</sub> O	0.002	nd
P <sub>2</sub> O <sub>5</sub>	0.01	0.01
S <sub>2</sub> O <sub>3</sub>	0.02	0.02
LOI	4.10	8.89
Sum	99.55	99.58
Mg#	92	93
Ti	261	159
V	31	26
Cr	828	898
Ni	3699	3391
Co	121	127
Ga	0.92	0.70
Rb	0.09	0.12
Sr	0.53	0.44
Ba	0.28	0.40
Y	1.12	0.61
Zr	3.8	1.5
Nb	0.17	0.11
Ta	0.01	0.02
Hf	0.12	0.08
La	0.19	0.18
Ce	0.57	0.42
Pr	0.08	0.04
Nd	0.35	0.21
Sm	0.13	0.10
Eu	0.02	0.02
Gd	0.20	0.08
Tb	0.03	0.02
Dy	0.19	0.09
Ho	0.05	0.03
Er	0.13	0.10
Yb	0.12	0.16
Lu	0.031	0.031
Th	0.06	0.03
U	0.03	0.01

nd--not detected.

Fe<sub>2</sub>O<sub>3</sub>\*, All Fe reported as Fe<sub>2</sub>O<sub>3</sub>

Major elements were analysed by XRF using a PW2400 dispersive X-ray fluorescence spectrometer at the Department of Geology, Australian National University. Agate-ground samples were prepared as fused glass discs and the flux used consisted of 12 parts lithium tetraborate to 22 parts lithium metaborate with a 1:10 sample to flux ratio.

Rare earth elements (REE) were determined as solutions on a Fisons PQ2+ STE ICP-MS at the Research School of Earth Sciences, ANU, following the procedures described in Eggins et al. (1997). After dissolution, a mixed element internal standard was added and an approx. 1,000 dilution in QD 2% HN03 prepared. Typical sensitivity was 3-5 10<sup>-7</sup> cps/ppm for 115 In and 238 U. Analysis time included four 90 s acquisition repeats. Isobaric and molecular interference corrections (mainly for oxides) procedural blank subtractions and drift corrections based on the mixed internal standard were made online using Fisons software. Concentrations were determined by reference to a single dilution of rock reference standard (BHVO-1) analysed with each batch. Analytical precision is typically less than or equal to 1% RSD (relative standard deviation) for elements >80 (except Lu).

**Table DR2.** Representative electron microprobe mineral analyses.

	G07/10			G07/32			G07/32					
	Olivine			Olivine			TiCl			TiCl		TiCh
	3b	5b	7a	SiO <sub>2</sub>	TiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	1	7	14	4	5	6
SiO <sub>2</sub>	40.45	39.94	40.41	SiO <sub>2</sub>	41.93	41.53	41.64	SiO <sub>2</sub>	37.18	37.45	37.64	34.52
TiO <sub>2</sub>	bd	0.07	0.06	TiO <sub>2</sub>	bd	bd	bd	TiO <sub>2</sub>	5.36	5.46	4.37	7.61
Al <sub>2</sub> O <sub>3</sub>	bd	0.34	bd	Al <sub>2</sub> O <sub>3</sub>	bd	bd	bd	Al <sub>2</sub> O <sub>3</sub>	bd	bd	bd	bd
Cr <sub>2</sub> O <sub>3</sub>	bd	0.11	0.08	Cr <sub>2</sub> O <sub>3</sub>	bd	0.14	bd	Cr <sub>2</sub> O <sub>3</sub>	bd	bd	bd	bd
FeO	9.29	8.35	8.18	FeO	2.62	2.11	2.45	FeO	3.95	3.69	3.27	2.42
MnO	0.21	0.23	0.22	MnO	0.12	0.13	0.18	MnO	0.18	0.24	0.26	0.32
MgO	49.55	50.24	50.17	MgO	55.36	55.59	55.25	MgO	51.57	51.56	53.19	52.50
NiO	0.70	0.55	0.35	NiO	0.50	0.36	0.31	NiO	0.40	0.31	0.28	0.23
CaO	bd	bd	bd	CaO	bd	bd	bd	CaO	bd	bd	bd	bd
sum	100.19	99.84	99.48	sum	100.53	99.87	99.83	Na <sub>2</sub> O	bd	bd	bd	bd
								K <sub>2</sub> O	bd	bd	bd	bd
No. O	4	4	4	No. O	4	4	4	total	98.66	98.71	99.01	97.60
Si	0.9911	0.9786	0.9909	Si	0.992	0.987	0.99					
Al	0.0099			Al				No. O	18	18	18	18
Ti	0.0013	0.0011	Ti					Si	4.104	4.122	4.123	3.854
Cr	0.0022	0.0016	Cr		0.003			Al				
Fe	0.1903	0.1711	0.1678	Fe	0.052	0.042	0.05	Ti	0.445	0.452	0.360	0.639
Mn	0.0043	0.0047	0.0046	Mn	0.002	0.003		Cr				
Mg	1.8096	1.8353	1.8342	Mg	1.952	1.970	1.96	Fe	0.365	0.340	0.300	0.226
Ni	0.0137	0.0108	0.0069	Ni	0.009	0.007	0.01	Mn	0.017	0.022	0.024	0.030
Ca				Ca				Mg	8.485	8.462	8.685	8.737
Mg#	0.90	0.91	0.92	Mg#	0.97	0.98	0.98	Ni	0.036	0.027	0.025	0.021
								Ca				
								Na				
								Mg#	0.96	0.96	0.97	0.97

Imaging and mineral data were acquired using a Jeol JSM-840A SEM fitted with an Oxford Instruments Isis energy dispersive system (EDS) with a germanium detector, in the Department of Earth Sciences, University of Oxford. Analytical conditions were a beam current of 5 nA and an accelerating voltage of 20 kV. Standard calibrations against a mixture of metals and synthetic and natural mineral phases were used and the data were corrected using ZAF procedures.

**Table DR3.** Representative LA-ICPMS analyses of olivine and Ti-Humite group minerals.

grain No.	G07/10 Olivines						G07/32 Olivines						G07/32 Ti-humite group minerals						Example analyses of NIST610 reference material interspersed with unknowns														
	10.2	13.1	13.2	15.1	A.2	1.2	2.2	2.4	3.1	3.3	1.2	1.3	2.1	2.2	6.2	D01	D07	D13	D19	F01	F07	F13	F19	F25	F31	NIST610	NIST610	NIST610	NIST610	NIST610	NIST610		
ppm																																	
Ca	664	1139	631	962	674	72	87	107	83	106	65	267	61	88	93	Mg24	472.35	449.82	470.69	467.47	465.39	463.48	478.82	446.18	468.67	468.21	NIST610	NIST610	NIST610	NIST610	NIST610	NIST610	
Sc	1.21	4.09	3.11	2.75	3.08	8.91	5.97	2.58	3.85	7.22	1.28	0.52	1.10	1.41	1.09	Si29	327104.4	327104.4	327104.4	327104.4	327104.4	327104.4	327104.4	327104.4	327104.4	327104.4	327104.4	327104.4	327104.4	327104.4	327104.4	327104.4	327104.4
Ti	31.41	46.61	60.46	51.17	42.83	7.73	7.25	19.07	7.81	29.88	17944	18376	16671	18917	20381	P31	336.12	363.52	328.5	346.1	327.29	363.98	321.93	362.25	357.46	321.61	NIST610	NIST610	NIST610	NIST610	NIST610	NIST610	
Ni	4634	4149	4256	4085	4135	4167	4420	3872	4065	4170	2940	2084	2427	2548	2781	Ca44	81901.09	82501.29	80290.47	82854.89	81257.03	81972.13	83096.09	81943.21	81668.97	81431.39	NIST610	NIST610	NIST610	NIST610	NIST610	NIST610	
Zr	0.283	0.084	0.092	0.215	0.155	0.531	0.735	0.821	0.663	1.209	11.87	16.56	10.07	7.12	7.63	Sc45	440.15	449.03	429.46	447.67	437.11	443.66	446.74	440.17	442.38	437.85	NIST610	NIST610	NIST610	NIST610	NIST610	NIST610	
Nb	0.042	0.020	0.055	0.037	0.034	0.082	0.111	0.113	0.043	0.230	19.03	28.31	37.46	23.80	13.76	Ti49	434.89	438.06	422.94	441.53	444.02	425.75	425.68	427.67	443.31	435.57	NIST610	NIST610	NIST610	NIST610	NIST610	NIST610	
Hf	0.011	0.001	0.007	0.003	nd	0.011	0.023	0.036	0.042	0.052	0.626	0.906	0.501	0.368	0.344	Ni60	446.33	448.49	426.67	456.72	437.98	452.41	449.83	439.84	437.62	447.33	NIST610	NIST610	NIST610	NIST610	NIST610	NIST610	
Ta	nd	nd	0.001	0.001	0.001	0.010	0.011	0.015	0.013	0.015	0.690	0.750	1.784	1.411	0.573	Zr90	435.67	452.95	430.76	442.34	435.74	445.97	442.52	438.18	437.43	440.59	NIST610	NIST610	NIST610	NIST610	NIST610	NIST610	
La	0.086	0.017	0.038	0.050	0.033	0.035	0.031	0.051	0.018	0.062	0.247	0.046	0.059	0.093	0.106	Nb93	414.29	436.91	405.96	423.98	417.09	421.93	421.38	419.23	418.57	418.85	NIST610	NIST610	NIST610	NIST610	NIST610	NIST610	
Ce	0.209	0.061	0.081	0.108	0.071	0.060	0.053	0.067	0.022	0.118	0.474	0.053	0.115	0.183	0.198	La139	451.04	475.83	447.24	458.71	451.27	461.57	465.34	459.5	457.06	452.7	NIST610	NIST610	NIST610	NIST610	NIST610	NIST610	
Pr	0.037	0.005	0.010	0.015	0.006	0.011	0.004	0.008	0.003	0.009	0.071	0.005	0.009	0.019	0.020	Ce140	442.33	462.61	440.53	447.99	441.61	452.53	455.81	449	447.29	443.63	NIST610	NIST610	NIST610	NIST610	NIST610	NIST610	
Nd	0.146	0.065	0.074	0.133	0.030	0.034	0.046	0.039	0.030	0.040	0.353	0.015	0.049	0.088	0.081	Pr141	426.95	436.93	426.51	429.63	424.4	433.37	437.89	430.77	429.43	425.9	NIST610	NIST610	NIST610	NIST610	NIST610	NIST610	
Sm	0.072	0.023	0.040	0.025	0.015	nd	0.007	0.004	0.019	0.020	0.052	0.008	0.012	0.022	0.027	Nd146	428.35	436.35	428.97	430.08	425.3	433.83	438.51	432.27	431.24	426.02	NIST610	NIST610	NIST610	NIST610	NIST610	NIST610	
Eu	0.008	0.003	0.006	0.002	0.003	0.004	0.002	0.002	0.001	0.008	0.004	0.002	0.006	0.004	Sm147	448.34	457.02	445.73	451.79	444.76	453.64	459	451.57	450.58	445.91	NIST610	NIST610	NIST610	NIST610	NIST610	NIST610		
Gd	0.066	0.043	0.056	0.020	0.024	0.007	0.012	0.016	0.009	0.010	0.089	0.044	0.026	0.030	0.019	Eu153	458.7	466.75	458.87	460.65	456.23	463.46	469.44	462.52	460.5	457.25	NIST610	NIST610	NIST610	NIST610	NIST610	NIST610	
Tb	0.017	0.009	0.011	0.012	0.004	0.003	0.003	0.001	0.003	0.022	0.010	0.005	0.004	0.007	Gd157	417.57	426.83	415.03	421.13	414.17	423.15	428.2	421.53	419.18	415.71	NIST610	NIST610	NIST610	NIST610	NIST610	NIST610		
Dy	0.103	0.058	0.090	0.072	0.045	0.013	0.022	0.034	0.011	0.020	0.177	0.137	0.081	0.046	0.070	Tb159	439.34	450.41	440.85	441.38	437.56	445.78	451.14	444.64	442.1	438.72	NIST610	NIST610	NIST610	NIST610	NIST610	NIST610	
Ho	0.026	0.015	0.019	0.017	0.014	0.005	0.013	0.011	0.007	0.016	0.048	0.058	0.032	0.020	0.022	Dy163	423.24	433.64	424.65	425.19	420.02	430.48	435.44	428.48	426.86	420.95	NIST610	NIST610	NIST610	NIST610	NIST610	NIST610	
Er	0.082	0.040	0.083	0.057	0.044	0.043	0.065	0.114	0.074	0.087	0.200	0.251	0.159	0.106	0.099	Ho165	446.75	455.06	448.11	448.19	443.54	452.9	457.78	452.23	449.03	444.36	NIST610	NIST610	NIST610	NIST610	NIST610	NIST610	
Tm	0.012	0.008	0.012	0.009	0.006	0.019	0.022	0.036	0.036	0.028	0.025	0.030	0.030	0.017	Er166	423.41	431.99	4															

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