Breeding et al., Data Repository Material
Figure DR1

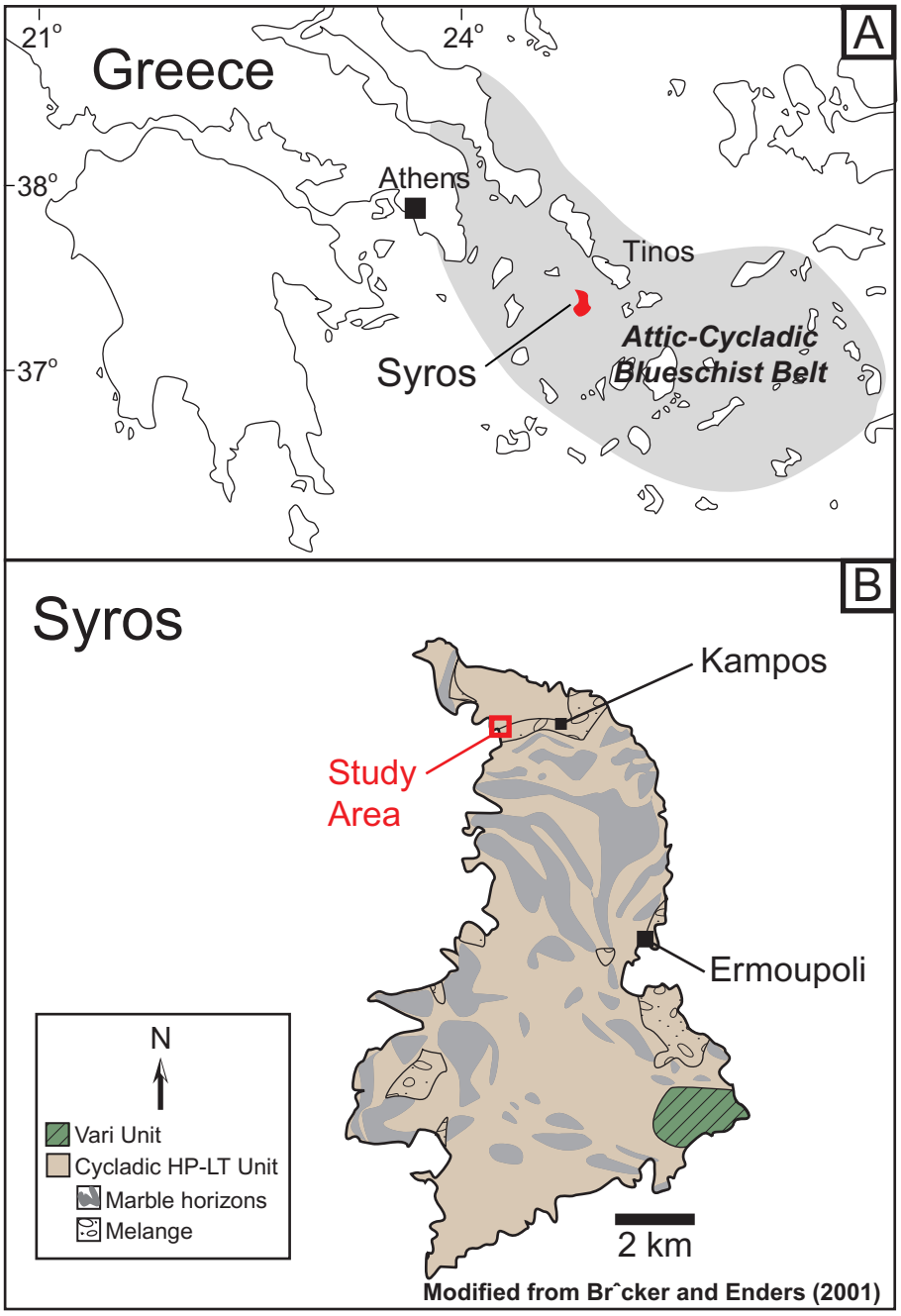

Figure DR1. Location and geologic maps of Syros. A. Map of Greece and Aegean showing Syros within HP-LT Attic-Cycladic Blueschist Belt. B. Geology of Syros showing Cycladic HP-LT unit with marbles and mÈlange and structurally overlying Vari Unit (not HP-LT). Study area at edge of mÈlange zone near Kampos marked by red square.

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Figure DR2

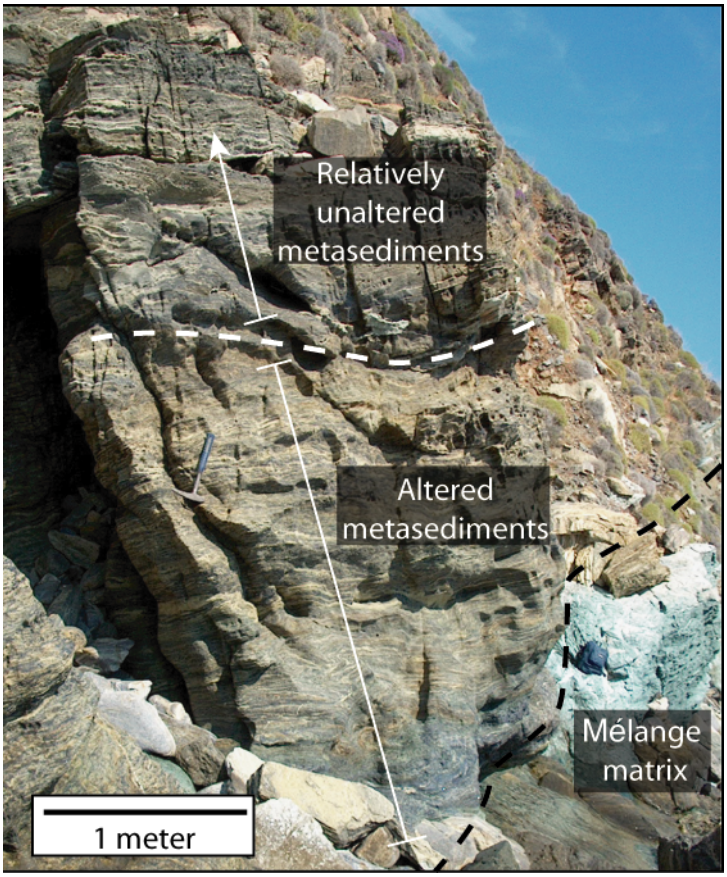

Figure DR2. Photograph of altered metasedimentary rocks at edge of Syros mÈlange zone. Visibly altered regions as thick as 2.5 meters in the metasediments are found adjacent to contacts with mÈlange matrix.

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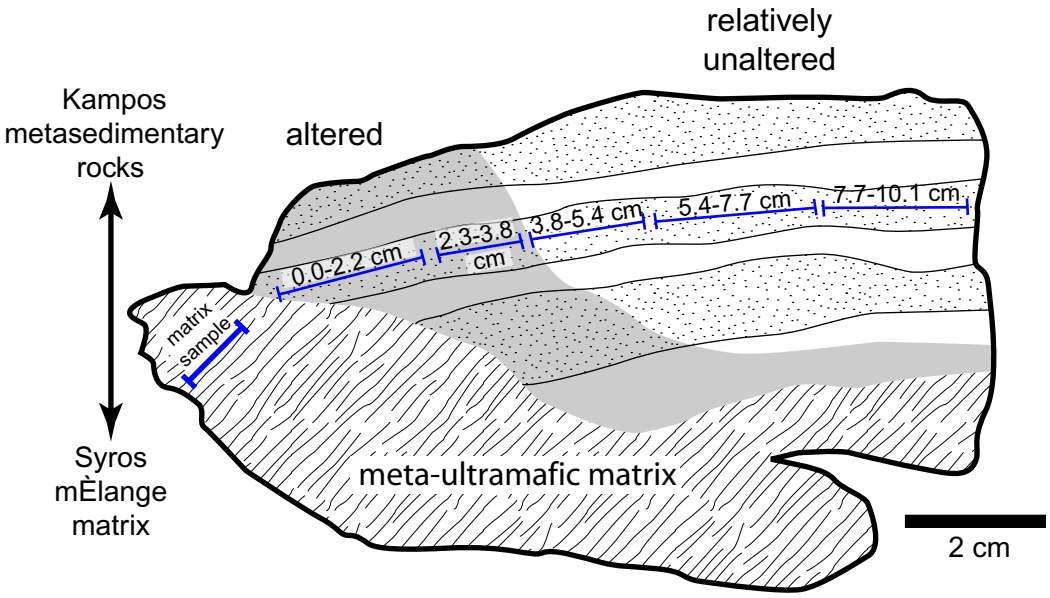
Figure DR3



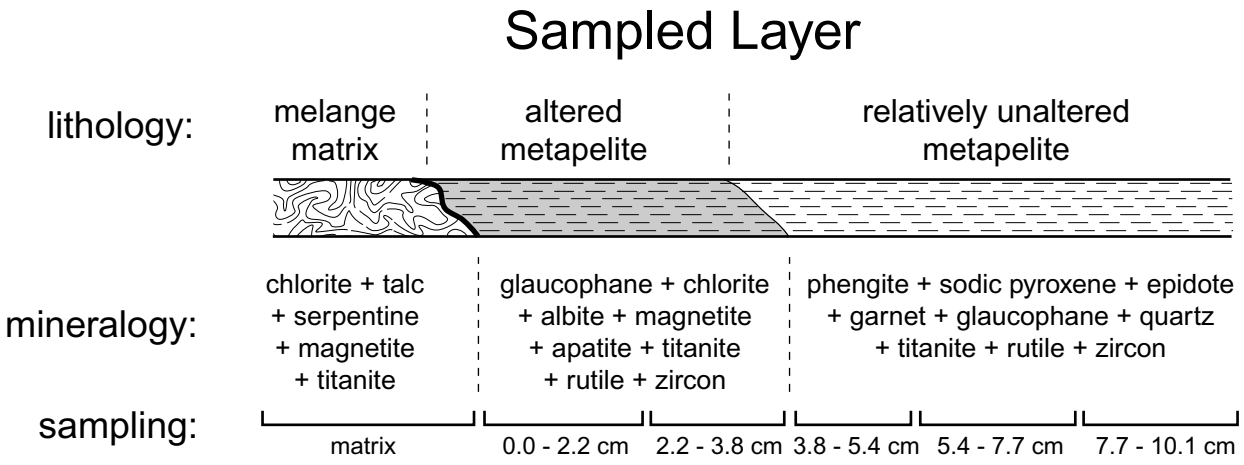


Figure DR3. Schematic diagram of sample showing mineral assemblages and sampling locations. Metasediments preserve primary interlayering of meta-psammite (non-patterned) and metapelite (stippled). Sampled layer consists of metapelite in direct contact with meta-ultramafic mÈlange matrix. Metasomatic alteration (gray shading) is visible near contact. Samples for analysis were taken every ~1.5 to 2 cm along metapelite layer (see sampling subdivisions) to investigate geochemical changes as matrix contact is approached.

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Figure DR4

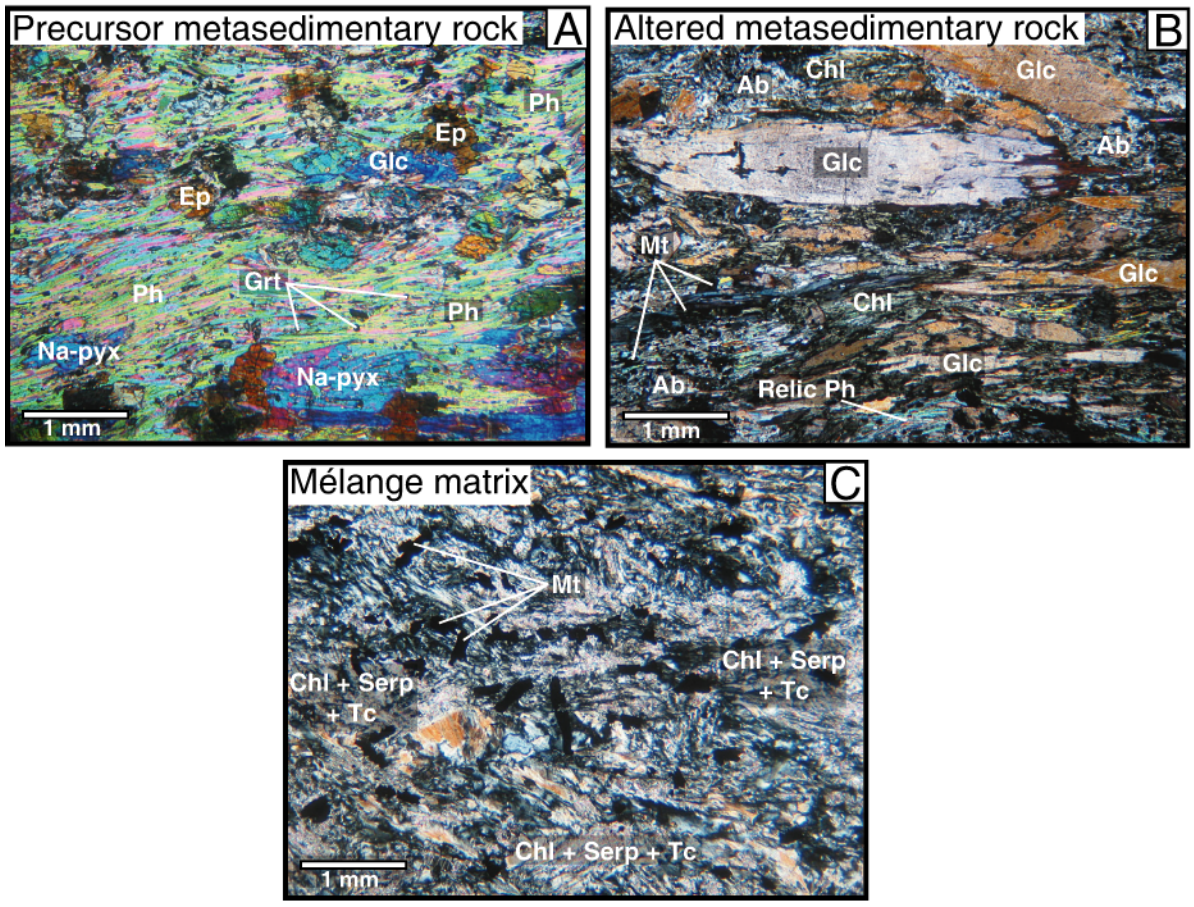

Figure DR4. Crossed-polarized photomicrographs of mineral assemblages from relatively unaltered metasedimentary rock, altered metasedimentary rock, and the mÈlange matrix. All scale bars are 1 mm long. A: Distal to contact with mÈlange, metasedimentary layer primarily contains phengite (Ph), sodic-pyroxene (Na-pyx), epidote (Ep), garnet (Grt), glaucophane (Glc), and quartz (not labeled). B: Within the alteration zone adjacent to the contact, the mineral assemblage is dominated by glaucophane (Glc), chlorite (Chl), albite (Ab), and magnetite (Mt), and includes relic phengite (Ph). Albite often contains abundant inclusions of magnetite. Note the larger grain size and higher abundance of glaucophane relative to part A. C: The meta-ultramafic matrix consists of fine-grained, intergrown chlorite (Chl), serpentine (Serp), and talc (Tc) with magnetite (Mt).

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Mineral Analysis

Mineral analyses were performed at Yale University on a JEOL JXA-8600 electron microprobe equipped with wavelength dispersive spectrometers using natural and synthetic standards, off-peak background corrections, and φ(ρz) matrix corrections. Standard analytical conditions were 15 kV accelerating voltage and 10 μm beam spots. Major and minor element acquisitions on all minerals were done with a 15 nA beam current and 10 second on-peak and off-peak count times. Pb and Cu concentrations in most phases were measured using a 50 nA beam current and count times of 300 seconds both on- and off-peak. For trace element analyses of hydrous minerals like phengite and chlorite, a 15 nA beam current and 20 μm beam spots were employed with longer count times of 600 seconds both on- and off-peak. Detection limits for Pb and Cu were 170 ppm and 120 ppm respectively (99 % confidence). Cu and Pb were consistently present in chlorite and epidote, respectively, whereas values were below detection in the other minerals (i.e., phengite, Na-pyroxene, garnet, glaucophane, albite, titanite, rutile, apatite, and magnetite). Detection limits for Sr in epidote and apatite were 210 and 130 ppm, respectively (99 % confidence). Epidotes have measured Sr concentrations as great as ~2600 ppm, whereas apatite Sr ranges from ~300 to ~450 ppm. Sr was below detection in the other minerals.

Thermobarometric calculations

Thermobarometric calculations made using Thermocalc V. 3.2 (Holland and Powell, 1998) at 500-550 ^{o}C (Trotet et al., 2001) and the reaction: 4 Albite + 2 Clinochlore = 2

Glaucophane + Amesite + 2 H_2O. Mineral compositions in alteration assemblage determined from electron microprobe analyses using AX software (Holland and Powell, 1998) and are as follows: albite = $NaAlSi_3O_8$; chlorite = $Mg_{3.517}\ Fe^{2+}_{1.156}\ Mn_{0.107}\ Al_{1.175}\ [Si_{2.902}Al_{1.098}]\ O_{10}\ [F_{0.032}(OH)_{7.968}]$; glaucophane = $Na_{1.992}\ Ca_{0.021}\ Mg_{2.488}\ Fe^{2+}_{0.435}\ Fe^{3+}_{0.584}\ Mn_{0.039}\ Al_{1.400}\ Si_{8.020}\ O_{22}\ [F_{0.065}(OH)_{1.935}]$. Cl contents were below detection in chlorite and glaucophane. H_2O activity was set at 1.0 based on a lack of significant halogen contents in hydrous minerals and fluid inclusion data from Syros indicating little CO_2 in HP-LT fluids (Barr, H., 1990, Preliminary fluid inclusion studies in a high-grade blueschist terrain, Syros, Greece: Mineralogical Magazine, v. 54, p. 159-168).

Calculation of amount of metasediment alteration needed for Ba extraction

The amount of fluid alteration of metasedimentary rocks necessary to remove enough Ba to enrich a volcanic eruption equivalent in size to the 1980 Mount St. Helens eruption, USA, by 100 ppm was done using the following parameters: Ba removed from metasediments during alteration = ~400 ppm (see Table DR1), Volume of Mount St. Helens eruption = ~0.4 km^3 (combined ash and pyroclastic volume taken from Tilling, R. I., Topinka, L. & Swanson, D. A., 1990, Eruptions of Mount St. Helens: Past, Present, and Future: USGS Special Interest Publication, 56 p.) Average densities of metasedimentary rock and erupted volcanic ash assumed to be 3.0 g/cm^3 and 2.3 g/cm^3, respectively.

Breeding et al., Data Repository Table DR1

Table DR1: Chemical analyses were performed by X-Ray Assay Laboratories (XRAL) in Don Mills, Ontario. Major elements were determined by XRF and are reported as wt% oxide. Trace elements were determined by ICP-MS and are reported as ppm. Total Fe is reported as Fe_2O_3. LOI is loss on ignition.

Sample	SY 51E-1	SY 51E-2	SY 51E-3	SY 51E-4	SY 51E-5	SY 51E-7
Dist. from ultramafic contact	0 - 2.2 cm	2.3 - 3.8 cm	3.8 - 5.1 cm	5.1 - 7.7 cm	7.7 - 10.1 cm	---
Description	Altered	Altered	Some alt.	Least alt.	Least alt.	Matrix
SiO_2	45.51	50.54	51.87	50.22	50.71	32.14
TiO_2*	0.90	0.80	0.65	0.57	0.58	1.09
Al_2O_3	13.99	14.16	15.77	15.68	15.23	14.64
Fe_2O_3	17.40	15.34	12.24	11.78	12.16	15.04
MnO	0.56	0.57	0.62	0.79	0.79	0.51
MgO	9.50	7.02	4.95	4.34	4.45	25.65
CaO	1.97	1.45	2.42	3.36	3.40	1.02
Na_2O	5.70	6.79	6.32	5.58	5.81	0.49
K_2O	0.13	0.19	2.12	3.64	3.27	0.04
P_2O_5	0.70	0.25	0.18	0.25	0.15	0.19
LOI	3.40	2.25	1.95	1.90	1.70	9.45
Total (wt %)	99.83	99.43	99.17	98.24	98.35	100.40
Rb	1.3	6.8	96.8	157	153	0.7
Sr	50.1	71.6	119	152	169	10.3
Y	47.1	45.2	40.8	39.5	37.4	47.8
Zr*	168	152	120	115	108	175
Nb*	15	13	11	10	9	15
Ba	4.7	18.7	251	418	392	2.5
La*	63.3	59.7	45.8	51.5	50.3	64.5
Ce*	125	114	80.5	80	77.6	124
Pr*	15.4	14.7	11	12.3	12.2	17
Nd*	58.3	55.5	42.7	46.6	46.5	62.4
Sm*	11.6	11.3	8.9	9.7	9.4	11.9
Eu*	2.82	2.83	2.25	2.35	2.23	1.78
Gd*	11.8	11.4	9.35	9.68	9.4	11.6
Tb*	1.77	1.75	1.51	1.57	1.47	1.81
Dy*	9.77	9.32	8.46	8.27	7.77	9.47
Ho*	2.05	1.92	1.74	1.74	1.64	2.01
Er*	5.59	5.57	4.77	4.71	4.36	5.39
Tm*	0.87	0.79	0.71	0.67	0.62	0.82
Yb*	5.3	5.2	4.4	4.2	4.2	5.3
Lu*	0.78	0.81	0.69	0.64	0.61	0.73
Th*	19.6	17.5	14	13.2	12.6	12.5
U	0.97	1.48	2.01	2.15	2.06	0.96
Pb	8	13	40	59	66	2.5
V	297	281	238	247	247	184
Co	88.1	86.2	72.9	79.2	79.4	103
Cu	66	56	45	18	18	61
Ga	18	16	17	18	18	24
Ni	286	246	214	190	184	581
Cs	0.1	0.6	7.8	12	11.2	0.05
Hf*	5	4	4	3	3	5
Zn	167	167	152	181	351	187

Note: Totals include major elements and Rb, Sr, Y, Zr, Nb, and Ba summed as oxides.

*Mass balance calculations indicate that metapelite lost ~36% rock mass at the contact with mélange matrix during fluid alteration. Raw concentrations of the limited mobility elements Zr, Th, Nb, Ti, Hf, and the REE increase slightly toward the contact, indicating residual enrichment due to the change in total rock mass rather than mass transfer of those elements (cf. Ague and van Haren, 1996; Ague, 2003).