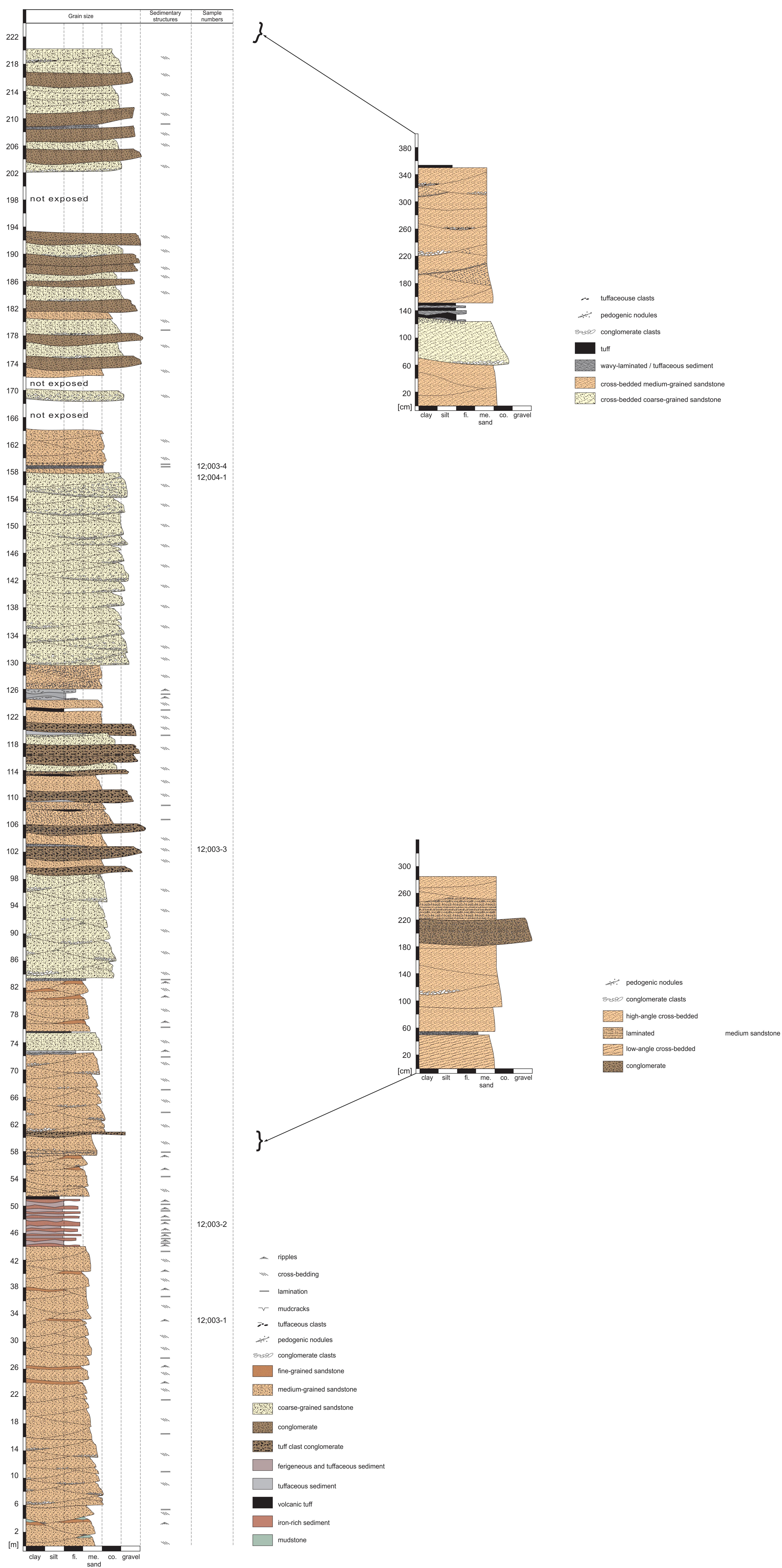


Figure DR1. A: Generalized geological map of the Barberton Greenstone Belt (modified after Heubeck and Lowe, 1994a). The area in the black rectangle is enlarged in B and shows a schematic geological map of the eastern Stolzburg Syncline and the location of sample 12;003-4 ( $25^{\circ}53.910'S$ ;  $30^{\circ}51.438'E$ ). AGC: Ancient Gneiss Complex, BGB: Barberton Greenstone Belt, DP: Dalmein Pluton, ES: Eureka Syncline, KVT: Kaap Valley Tonalite, MHB: Moodies Hills Block, SbS: Stolzburg Syncline.

Figure DR2. Stratigraphic column of unit MdQ1 of the lower Moodies Group in the eastern Stolzburg Syncline. The column shows about 220 m of mainly channelized medium- to coarse-grained sandstone in braided-fluvial facies, including the analyzed sample (12;003-4) at m 159. Shorter columns to the right show detailed measured sections.

Figure DR2



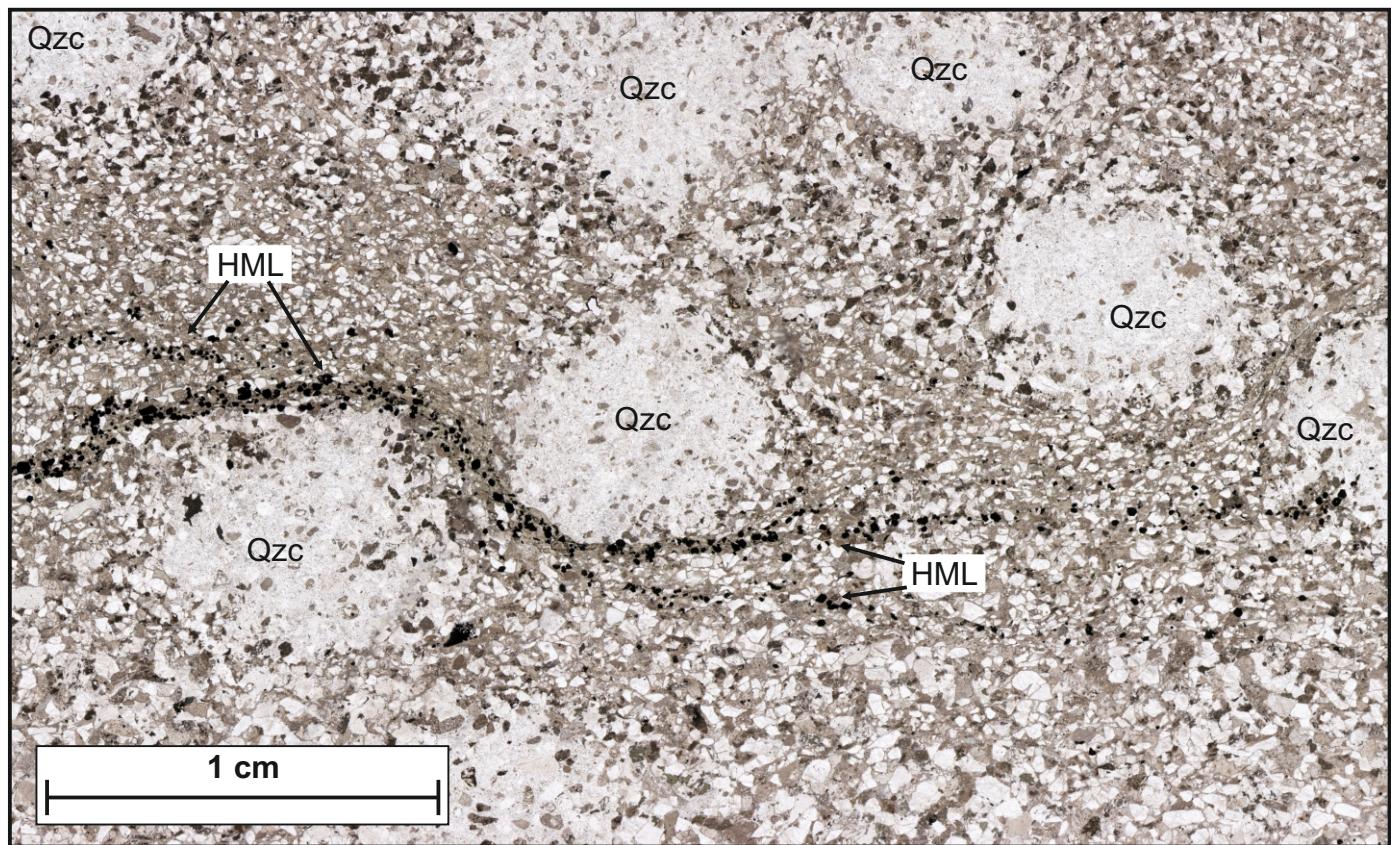


Figure DR3. Transmitted-light image of a representative thin section of sample 12;003-4. Unconsolidated sand, including a heavy-mineral lamina (HML) mainly composed of opaque pyrite, was deformed by compaction around early-silicified concretions (Qzc). Some heavy mineral grains are overgrown by the concretion to the right.

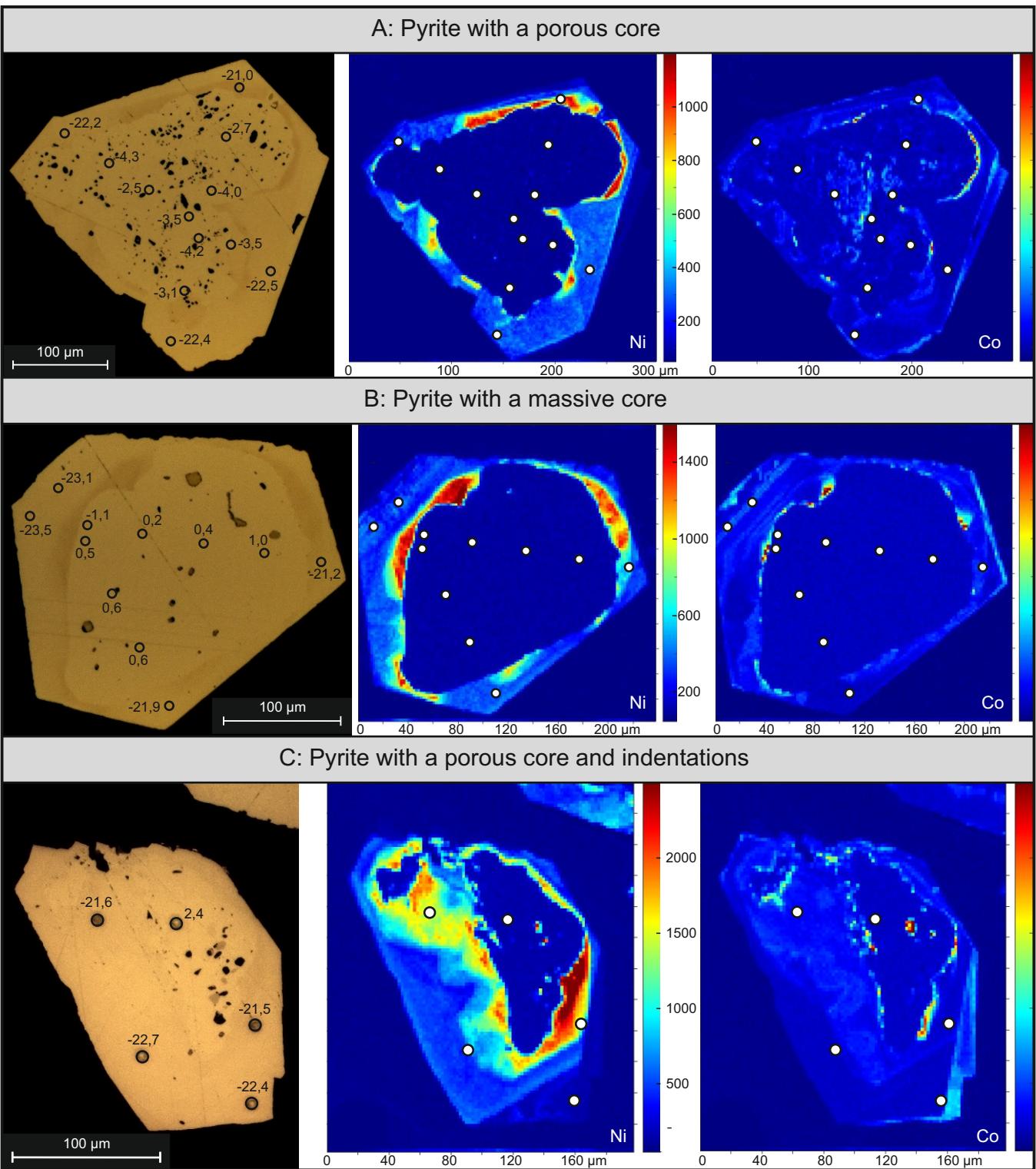


Figure DR4. Reflected-light images (left) and TE maps (center, Ni; right, Co) of representative pyrite grains. SIMS ablation pits are marked by open (left) and filled (center, right) circles.  $\delta^{34}\text{S}_{\text{VCDT}}$  values are noted in the RL images (left). A: Representative pyrite grain with a porous core showing negative  $\delta^{34}\text{S}$  values. B: Representative pyrite grain with a massive core showing slightly positive  $\delta^{34}\text{S}$  values. C: Representative pyrite grain with a porous core showing indentations and partial dissolution. The patches of high-TE concentration in the core represent pores filled by secondary pyrite. All grains show a zone of low-TE concentration with slightly heavier  $\delta^{34}\text{S}$  values than the zone of high- TE concentration. Color bars to the right show counts per second (cps) of the named TE.



Figure DR5. Thinn section photomicrograph of a granule sandstone with reworked nodules. The large nodule to the upper left shows internal zoning with inward-pointing crystal faces (black arrows) and contains opaque pyrite and magnetite (encircled). The large clast to the upper right is made of chert. The granule lamina in the lower part of the image contains a small reworked nodule (red circle).

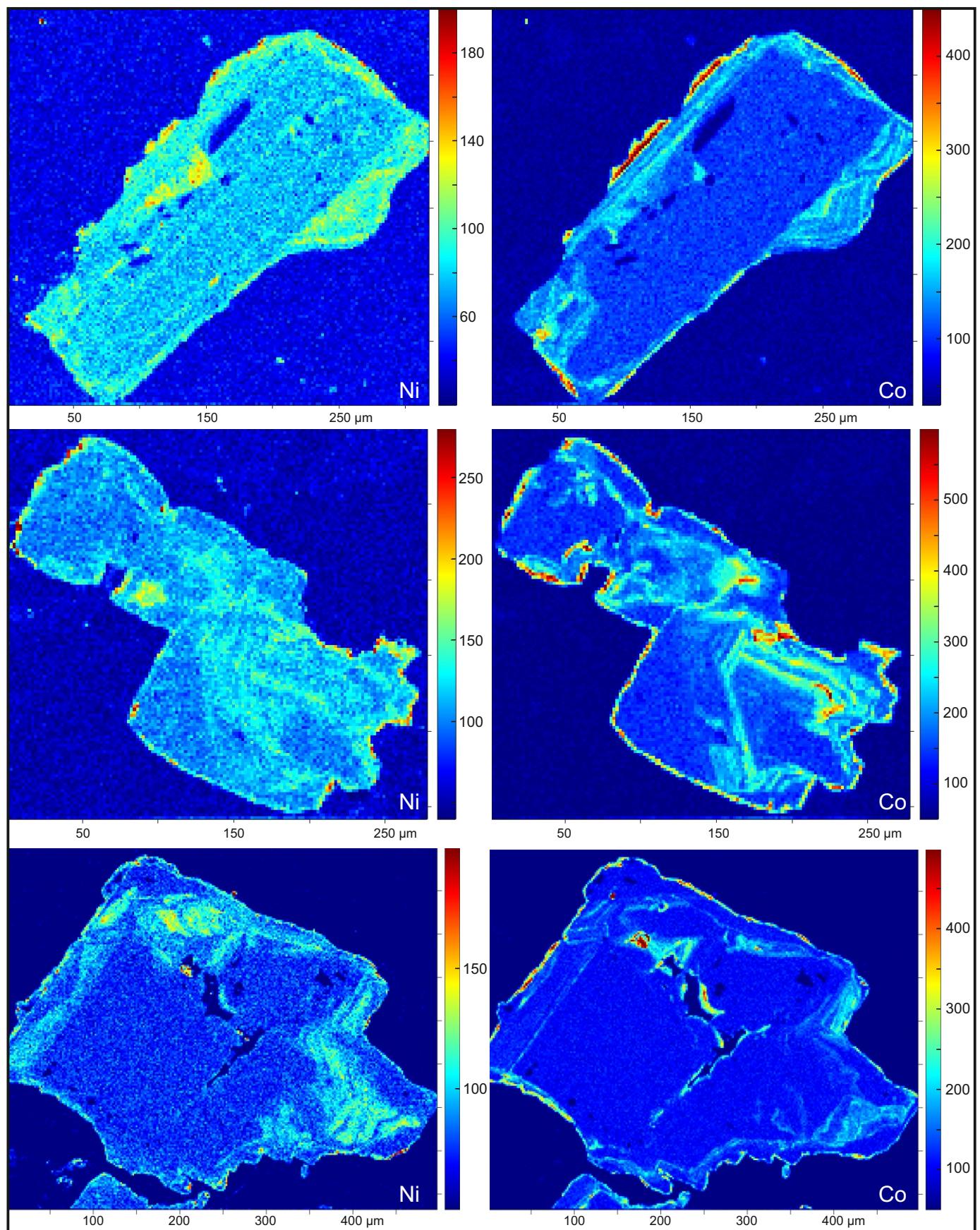


Figure DR6. TE maps (left, Ni; right, Co) of metamorphic pyrite from the Eureka Syncline. TE concentrations, especially of Ni, are generally lower than in the secondary pyrite rims shown in Fig. 2 and DR4. Zoning is visible but poorly defined and there is no expression of detrital cores. Color bars to the right show counts per second (cps) of the named TE.

TABLE DR1. EPMA RESULTS OF ZONED PYRITE GRAINS SHOWING THEIR ELEMENTAL COMPOSITION

Analysis number		Fe (wt.%)	S (wt.%)	Cu (wt.%)	Ni (wt.%)	Co (wt.%)	Total	Co/Ni	Zone
12;003-4f	1	43.974	51.417	0.000	2.474	0.661	98.526	0.27	rim
	2	43.974	51.254	0.000	0.003	0.072	97.674	24.00	core
	3	43.974	51.075	0.010	0.005	0.076	97.057	15.20	core
	6	43.974	48.182	0.032	0.004	0.078	93.843	19.50	core
	7	43.974	50.855	0.005	4.128	0.544	97.859	0.13	rim
	8	43.974	50.806	0.000	0.003	0.069	97.172	23.00	core
	11	43.974	50.637	0.000	0.894	0.145	97.609	0.16	rim
	12	43.974	50.651	0.004	2.656	0.072	97.750	0.03	rim
	13	43.974	48.078	0.009	0.006	0.073	94.574	12.17	core
	14	43.974	50.628	0.000	1.733	0.595	97.284	0.34	rim
	15	43.974	50.641	0.004	0.004	0.073	97.247	18.25	core
	16	43.974	50.778	0.000	4.407	1.048	98.167	0.24	rim
	17	43.974	50.445	0.002	0.010	0.185	96.263	18.50	core
	18	43.974	50.582	0.000	1.159	0.098	97.146	0.08	rim
	19	43.974	50.475	0.001	1.313	0.135	96.725	0.10	rim
	20	43.974	50.168	0.002	0.010	0.071	96.631	7.10	core
	21	43.974	50.588	0.006	0.008	0.072	97.155	9.00	core
	22	43.974	50.211	0.000	0.791	0.079	96.902	0.10	rim
	23	43.974	49.902	0.000	0.028	0.097	96.633	3.46	core
	24	43.974	50.312	0.006	1.225	0.129	96.747	0.11	rim
	25	43.974	50.126	0.009	0.051	0.135	96.532	2.65	core
	26	43.974	50.112	0.001	0.024	0.102	96.251	4.25	core
	27	43.974	50.256	0.005	0.081	0.118	96.170	1.46	core
	28	43.974	50.430	0.000	3.411	0.132	97.047	0.04	rim
	29	43.974	50.017	0.011	0.106	0.179	96.193	1.69	core
	30	43.974	50.231	0.000	0.011	0.078	96.900	7.09	core
	31	43.974	50.630	0.002	0.993	0.079	97.493	0.08	rim
	32	43.974	50.466	0.001	0.004	0.082	96.976	20.50	core
	33	43.974	50.107	0.002	0.017	0.074	96.082	4.35	core
	34	43.974	50.563	0.004	3.226	0.215	97.202	0.07	rim
	35	43.974	50.517	0.000	4.143	0.281	97.992	0.07	rim
	36	43.974	50.406	0.000	0.004	0.085	97.149	21.25	core
	37	43.974	50.455	0.000	0.007	0.094	97.042	13.43	core
12;003-4g	1	43.974	53.959	0.028	0.148	0.307	100.656	2.07	core
	2	43.974	53.321	0.023	0.006	0.031	99.445	5.17	core
	3	43.974	54.515	0.013	0.011	0.015	101.425	1.36	core
	4	43.974	54.737	0.012	3.251	0.261	101.896	0.08	rim
	5	43.974	54.393	0.531	1.614	0.147	101.373	0.09	rim
	6	43.974	54.496	0.013	0.134	0.007	101.388	0.05	core
	9	43.974	54.490	0.016	0.075	0.037	101.568	0.49	core

10	43.974	54.422	0.005	0.536	0.007	101.174	0.01	rim
11	43.974	54.637	0.024	3.348	0.176	101.767	0.05	rim
12	43.974	54.192	0.032	0.030	0.091	100.745	3.03	core
13	43.974	54.689	0.021	0.007	0.007	101.685	1.00	core
14	43.974	53.869	0.015	0.006	0.003	100.408	0.50	core
17	43.974	54.666	0.009	0.776	0.063	101.805	0.08	rim
18	43.974	53.930	0.017	0.088	0.095	100.667	1.08	core
19	43.974	54.829	0.012	0.976	0.018	101.957	0.02	rim
20	43.974	53.251	0.028	0.056	0.033	98.665	0.59	core

*Note:* Ni and Co values are plotted in Fig. 1. Zones were defined using RL microscopy and TE maps.

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TABLE DR2. SIMS RESULTS OF ZONED PYRITE GRAINS SHOWING THEIR S-ISOTOPIC COMPOSITION.

Sample	Analysis Nr.	34S/32S	$\delta^{34}\text{S}$ 1sd (‰)	$\delta^{34}\text{S}$ (‰)	Zone
12:003-4g	Grain1@1	0.0443	0.046	2.495	massive core
	Grain1@2	0.0443	0.031	2.369	massive core
	Grain1@3	0.0432	0.044	-22.725	low-TE rim
	Grain1@4	0.0432	0.040	-21.944	high-TE rim
	Grain2@1	0.0443	0.030	2.000	massive core
	Grain2@2	0.0442	0.057	0.485	massive core
	Grain2@3	0.0432	0.036	-20.762	high-TE rim
	Grain2@4	0.0432	0.034	-22.526	low-TE rim
	Grain2@5	0.0432	0.041	-22.025	low-TE rim
	Grain3@1	0.0441	0.033	-0.987	massive core
	Grain3@2	0.0433	0.038	-20.122	high-TE rim
	Grain3@3	0.0432	0.037	-21.145	high-TE rim
	Grain3@4	0.0432	0.034	-22.594	low-TE rim
	Grain4@1	0.0441	0.029	-1.139	massive core
	Grain4@2	0.0432	0.037	-22.368	low-TE rim
	Grain4@3	0.0437	0.036	-10.473	transitional
	Grain4@4	0.0431	0.040	-23.059	low-TE rim
	Grain4@5	0.0433	0.044	-18.676	high-TE rim
	Grain5@1	0.0441	0.029	-2.204	massive core
	Grain5@2	0.0441	0.028	-1.805	massive core
	Grain5@3	0.0431	0.034	-23.236	low-TE rim
	Grain6@1	0.0440	0.030	-3.554	porous core
	Grain6@2	0.0434	0.045	-16.693	transitional
	Grain6@3	0.0432	0.029	-22.631	low-TE rim
	Grain7@1	0.0438	0.054	-8.404	transitional
	Grain7@2	0.0443	0.032	2.359	massive core
	Grain7@3	0.0442	0.033	0.993	massive core
	Grain7@4	0.0432	0.033	-21.243	high-TE rim
	Grain7@5	0.0442	0.028	1.631	massive core
	Grain7@6	0.0435	0.035	-15.709	transitional
	Grain8@1	0.0442	0.032	-0.094	porous core
	Grain8@2	0.0439	0.028	-6.882	transitional
	Grain8@3	0.0431	0.038	-23.754	low-TE rim
	Grain8@4	0.0431	0.029	-24.107	low-TE rim
	Grain8@5	0.0432	0.029	-21.555	high-TE rim
	Grain8@6	0.0432	0.028	-22.882	high-TE rim
	Grain10@1	0.0441	0.035	-2.032	massive core
	Grain10@2	0.0441	0.028	-0.519	massive core
	Grain10@3	0.0442	0.030	1.493	massive core
	Grain10@4	0.0431	0.043	-23.779	low-TE rim
	Grain10@5	0.0434	0.041	-16.518	transitional
	Grain10@6	0.0431	0.033	-23.356	low-TE rim
	Grain11@1	0.0432	0.033	-21.009	high-TE rim
	Grain11@2	0.0443	0.027	2.693	massive core
	Grain11@3	0.0443	0.040	2.403	massive core

Grain11@4	0.0442	0.041	1.470	massive core
Grain11@5	0.0437	0.029	-10.072	transitional
Grain11@6	0.0431	0.028	-23.774	low-TE rim
Grain12@1	0.0443	0.030	2.354	porous core
Grain12@2	0.0432	0.036	-21.500	high-TE rim
Grain12@3	0.0432	0.044	-22.379	low-TE rim
Grain12@4	0.0432	0.033	-22.749	low-TE rim
Grain12@5	0.0432	0.028	-21.603	high-TE rim
Grain13@1	0.0442	0.045	0.526	massive core
Grain13@2	0.0442	0.036	0.657	massive core
Grain13@3	0.0431	0.041	-23.778	low-TE rim
Grain13@4	0.0432	0.031	-21.086	high-TE rim
Grain14@1	0.0436	0.060	-13.630	high-TE rim
Grain14@2	0.0441	0.034	-0.424	porous core
Grain14@3	0.0435	0.039	-14.897	transitional
Grain14@4	0.0443	0.027	2.315	massive core
Grain14@5	0.0443	0.027	3.105	massive core
Grain14@6	0.0443	0.035	3.254	massive core
Grain14@7	0.0435	0.047	-16.097	transitional
Grain14@8	0.0431	0.027	-22.973	low-TE rim
Grain14@9	0.0443	0.027	2.660	massive core
Grain14@10	0.0442	0.045	1.801	massive core
Grain14@11	0.0443	0.030	2.774	massive core
Grain14@12	0.0431	0.033	-23.479	low-TE rim
Grain15@1	0.0435	0.044	-15.720	high-Co rim
Grain15@2	0.0432	0.031	-22.469	low-TE rim
Grain15@3	0.0443	0.028	2.323	massive core
Grain15@4	0.0443	0.028	2.151	massive core
Grain15@5	0.0432	0.045	-21.817	high-TE rim
Grain16@1	0.0433	0.051	-18.483	high-Co rim
Grain16@2	0.0433	0.097	-20.451	high-TE rim
Grain16@3	0.0443	0.039	2.357	massive core
Grain16@4	0.0443	0.041	2.007	massive core
Grain16@5	0.0437	0.068	-10.942	transitional
Grain16@6	0.0432	0.034	-21.157	low-TE rim
Grain16@7	0.0443	0.035	1.984	massive core
Grain16@8	0.0442	0.037	1.716	massive core
Grain16@9	0.0432	0.032	-21.107	low-TE rim
Grain17@1	0.0432	0.046	-21.790	high-TE rim
Grain17@2	0.0442	0.054	-0.071	porous core
Grain17@3	0.0442	0.039	0.997	porous core
Grain17@4	0.0441	0.031	-0.516	porous core
Grain17@5	0.0431	0.035	-23.292	low-TE rim
Grain17@6	0.0434	0.031	-16.808	transitional
Grain17@7	0.0443	0.031	2.944	porous core
Grain17@8	0.0441	0.042	-1.214	porous core
Grain17@9	0.0432	0.029	-22.443	low-TE rim
Grain18@1	0.0431	0.040	-24.478	low-TE rim
Grain18@2	0.0436	0.041	-11.924	transitional
Grain18@3	0.0441	0.037	-0.487	porous core

	Grain18@4	0.0441	0.035	-0.353	porous core
	Grain18@5	0.0433	0.029	-19.180	high-TE rim
	Grain18@6	0.0437	0.040	-11.026	transitional
<u>12:003-4a</u>	<u>Grain1@1</u>	<u>0.0431</u>	<u>0.028</u>	<u>-23.525</u>	<u>low-TE rim</u>
	Grain1@2	0.0434	0.028	-17.392	high-TE rim
	Grain1@3	0.0437	0.028	-11.215	transitional
	Grain1@4	0.0434	0.028	-16.715	transitional
	Grain2@1	0.0432	0.028	-22.706	low-TE rim
	Grain2@2	0.0432	0.028	-22.682	low-TE rim
	Grain2@3	0.0432	0.028	-22.721	low-TE rim
	Grain2@4	0.0432	0.029	-21.295	high-TE rim
	Grain2@5	0.0443	0.028	3.335	porous core
	Grain2@6	0.0432	0.028	-22.284	low-TE rim
	Grain2@7	0.0432	0.028	-22.821	low-TE rim
	Grain2@8	0.0432	0.028	-21.202	high-TE rim
	Grain3@2	0.0432	0.028	-22.800	low-TE rim
	Grain3@3	0.0432	0.029	-20.825	high-TE rim
	Grain3@4	0.0441	0.035	-1.602	porous core
	Grain3@5	0.0432	0.028	-20.910	high-TE rim
	Grain3@6	0.0432	0.028	-21.270	low-TE rim
	Grain3@7	0.0442	0.028	0.224	massive core
	Grain4@1	0.0431	0.028	-24.347	low-TE rim
	Grain4@2	0.0432	0.028	-21.281	high-TE rim
	Grain4@3	0.0443	0.028	3.334	massive core
	Grain4@4	0.0444	0.028	4.242	massive core
	Grain4@5	0.0432	0.028	-21.258	high-TE rim
	Grain4@6	0.0432	0.028	-21.639	high-TE rim
	Grain4@7	0.0442	0.028	1.839	massive core
	Grain4@8	0.0443	0.028	3.638	massive core
	Grain4@9	0.0443	0.028	3.260	massive core
	Grain4@10	0.0431	0.028	-23.826	low-TE rim
	Grain5@1	0.0432	0.028	-21.049	high-TE rim
	Grain5@2	0.0442	0.029	-0.117	porous core
	Grain5@3	0.0441	0.028	-0.542	porous core
	Grain5@4	0.0432	0.028	-20.868	high-TE rim
	Grain6@1	0.0442	0.028	1.792	massive core
	Grain6@2	0.0443	0.028	2.084	massive core
	Grain6@3	0.0431	0.028	-23.116	low-TE rim
	Grain8@1	0.0432	0.028	-22.241	low-TE rim
	Grain8@2	0.0440	0.028	-4.291	porous core
	Grain8@3	0.0441	0.028	-2.490	porous core
	Grain8@4	0.0440	0.028	-3.483	porous core
	Grain8@5	0.0440	0.028	-3.545	porous core
	Grain8@6	0.0432	0.028	-22.480	low-TE rim
	Grain8@7	0.0432	0.028	-21.046	high-TE rim
	Grain8@8	0.0440	0.028	-2.689	porous core
	Grain8@9	0.0440	0.028	-4.048	porous core
	Grain8@10	0.0440	0.029	-4.204	porous core
	Grain8@11	0.0440	0.030	-3.145	porous core
	Grain8@12	0.0432	0.028	-22.419	low-TE rim

Grain9@1	0.0433	0.028	-20.024	high-TE rim
Grain9@2	0.0442	0.027	1.225	massive core
Grain9@3	0.0441	0.027	-0.813	massive core
Grain9@4	0.0433	0.028	-20.221	high-TE rim
Grain9@5	0.0434	0.028	-17.414	transitional
Grain10@1	0.0431	0.028	-23.117	low-TE rim
Grain10@2	0.0442	0.027	0.526	massive core
Grain10@3	0.0442	0.027	0.619	massive core
Grain10@4	0.0442	0.027	0.604	massive core
Grain10@5	0.0432	0.028	-21.921	low-TE rim
Grain10@6	0.0431	0.028	-23.497	low-TE rim
Grain10@7	0.0441	0.028	-1.075	massive core
Grain10@8	0.0442	0.027	0.218	massive core
Grain10@9	0.0442	0.027	0.438	massive core
Grain10@10	0.0442	0.027	0.955	massive core
Grain10@11	0.0432	0.028	-21.206	high-TE rim
Grain11@1	0.0432	0.028	-20.810	high-TE rim
Grain11@2	0.0439	0.028	-5.262	porous core
Grain11@3	0.0439	0.028	-4.969	porous core
Grain11@4	0.0439	0.028	-4.978	porous core
Grain11@5	0.0433	0.028	-19.792	high-TE rim
Grain11@6	0.0431	0.028	-23.966	low-TE rim
Grain11@7	0.0432	0.028	-22.596	low-TE rim
Grain11@8	0.0439	0.028	-5.055	porous core
Grain11@9	0.0439	0.028	-4.957	porous core
Grain11@10	0.0439	0.028	-5.198	porous core
Grain11@11	0.0432	0.028	-21.140	high-TE rim
Grain11@12	0.0434	0.028	-16.990	high-Co rim
Grain12@1	0.0431	0.028	-23.861	low-TE rim
Grain12@2	0.0439	0.028	-6.961	transitional
Grain12@3	0.0442	0.027	-0.283	porous core
Grain12@4	0.0443	0.035	3.415	porous core
Grain12@5	0.0440	0.028	-3.244	porous core
Grain13@1	0.0440	0.028	-4.147	porous core
Grain13@2	0.0441	0.028	-1.422	porous core
Grain13@3	0.0441	0.028	-1.420	porous core
Grain13@4	0.0432	0.028	-21.271	high-TE rim
Grain13@5	0.0432	0.028	-22.615	low-TE rim
Grain13@6	0.0432	0.028	-22.641	low-TE rim
Grain13@7	0.0441	0.028	-1.407	porous core
Grain13@8	0.0441	0.028	-1.671	porous core
Grain13@9	0.0441	0.028	-1.608	porous core
Grain13@10	0.0431	0.028	-22.985	low-TE rim
Grain14@1	0.0431	0.028	-24.242	low-TE rim
Grain14@2	0.0432	0.028	-22.014	high-TE rim
Grain14@3	0.0440	0.028	-2.600	porous core
Grain14@4	0.0440	0.028	-2.738	porous core
Grain14@5	0.0441	0.028	-1.755	porous core
Grain14@6	0.0431	0.028	-23.173	low-TE rim
Grain15@1	0.0432	0.028	-22.557	low-TE rim

Grain15@2	0.0440	0.028	-3.083	porous core
Grain15@3	0.0440	0.028	-2.988	porous core
Grain15@4	0.0440	0.028	-2.835	porous core
Grain15@5	0.0432	0.028	-22.797	low-TE rim
Grain18@1	0.0431	0.028	-24.085	low-TE rim
Grain18@2	0.0432	0.028	-22.142	high-TE rim
Grain18@3	0.0443	0.028	2.759	porous core
Grain18@4	0.0443	0.028	3.250	porous core
Grain18@5	0.0432	0.028	-22.192	low-TE rim
Grain18@6	0.0433	0.028	-20.650	high-TE rim
Grain18@7	0.0443	0.028	2.056	porous core
Grain18@8	0.0443	0.028	3.066	porous core
Grain18@9	0.0436	0.028	-13.161	high-Co rim
Grain19@1	0.0431	0.028	-23.042	low-TE rim
Grain19@2	0.0443	0.028	2.647	massive core
Grain19@3	0.0443	0.028	2.933	massive core
Grain19@4	0.0443	0.028	2.614	massive core
Grain19@5	0.0432	0.028	-21.723	high-TE rim
Grain19@6	0.0431	0.028	-23.836	low-TE rim
Grain19@7	0.0431	0.028	-23.554	low-TE rim
Grain19@8	0.0432	0.028	-21.080	high-TE rim
Grain19@9	0.0442	0.028	1.270	massive core
Grain19@10	0.0442	0.028	0.613	massive core
Grain19@11	0.0432	0.028	-22.606	high-TE rim
Grain19@12	0.0431	0.028	-23.858	low-TE rim
Grain20@1	0.0442	0.028	1.958	porous core
Grain20@2	0.0441	0.028	-1.158	porous core
Grain20@3	0.0435	0.028	-15.981	transitional
Grain21@1	0.0431	0.028	-23.411	low-TE rim
Grain21@2	0.0443	0.028	2.959	porous core
Grain21@3	0.0443	0.028	2.032	porous core
Grain21@4	0.0432	0.028	-21.551	high-TE rim
Grain21@5	0.0432	0.029	-22.111	low-TE rim

*Note:* Values are plotted in Fig. 3. The positions of the spots were defined using EPMA TE maps.

TABLE DR3. SIMS RESULTS OF GM3-BALL (BALMAT PYRITE) STANDARD

Sample	Analysis Nr.	34S/32S	$\delta^{34}\text{S}$ 1sd (‰)	$\delta^{34}\text{S}$ (‰)
GM3-Bal 1	Std@01	0.044839	0.038	15.31
session 1	Std@02	0.044821	0.055	14.91
	Std@03	0.044832	0.037	15.16
	Std@04	0.044839	0.036	15.31
	Std@05	0.044830	0.031	15.11
	Std@06	0.044826	0.033	15.01
	Std@07	0.044831	0.039	15.13
	Std@08	0.044828	0.032	15.06
	Std@09	0.044829	0.038	15.09
	Std@10	0.044829	0.028	15.09
	Std@11	0.044829	0.028	15.07
	Std@12	0.044822	0.030	14.93
	Std@13	0.044826	0.028	15.01
	Std@14			
	Std@15	0.044824	0.032	14.96
	Std@16	0.044826	0.029	15.01
	Std@17	0.044834	0.034	15.19
	Std@18	0.044839	0.029	15.30
	Std@19	0.044822	0.037	14.92
	Std@20	0.044830	0.028	15.09
	Std@21	0.044831	0.028	15.13
	Std@22	0.044833	0.040	15.17
	Std@23	0.044835	0.035	15.23
GM3-Bal 2	std@1	0.0448	0.027	15.03
session 2	std@02	0.0448	0.027	15.07
	std@03	0.0448	0.027	15.12
	std@04	0.0448	0.027	15.20
	std@05	0.0448	0.027	15.22
	std@06	0.0448	0.027	15.00
	std@07	0.0448	0.027	15.19
	std@08	0.0448	0.027	14.92
	std@09	0.0448	0.027	15.05
	std@10	0.0448	0.027	15.18
	std@11	0.0448	0.027	15.04
	std@12	0.0448	0.027	15.13
	std@13	0.0448	0.027	15.26
	std@14	0.0448	0.027	15.15
	std@15	0.0448	0.027	15.06
	std@16	0.0448	0.027	14.99

Note: Session 1 relates to sample 12;003-4g; session 2 to sample 12;003-4a, respectively.