MODIFIED TECHNIQUE OF MASS BALANCE CALCULATION FOR PALEOSOLS APPLIED TO THE EDIACARAN BASALT WEATHERING CRUSTS

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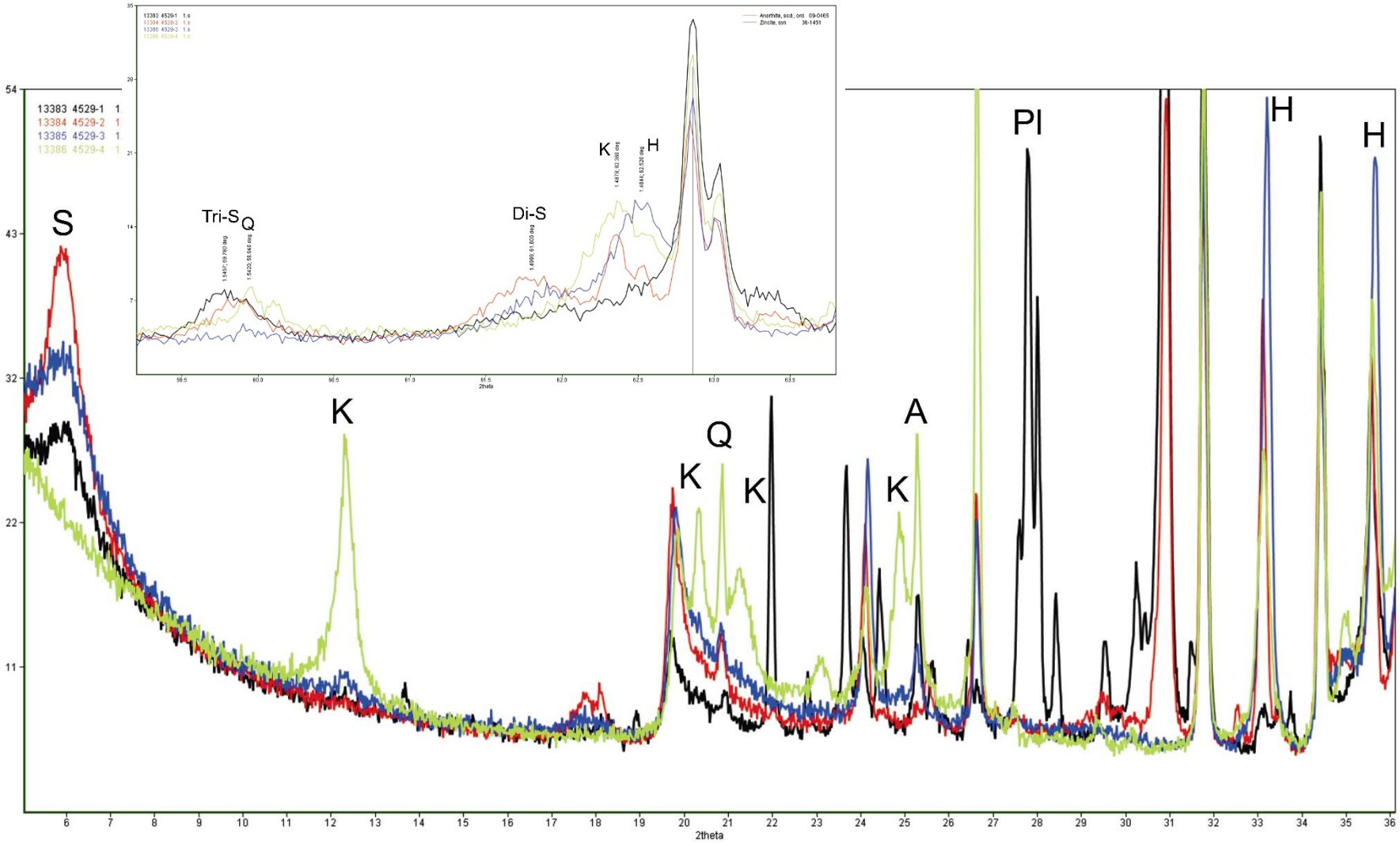
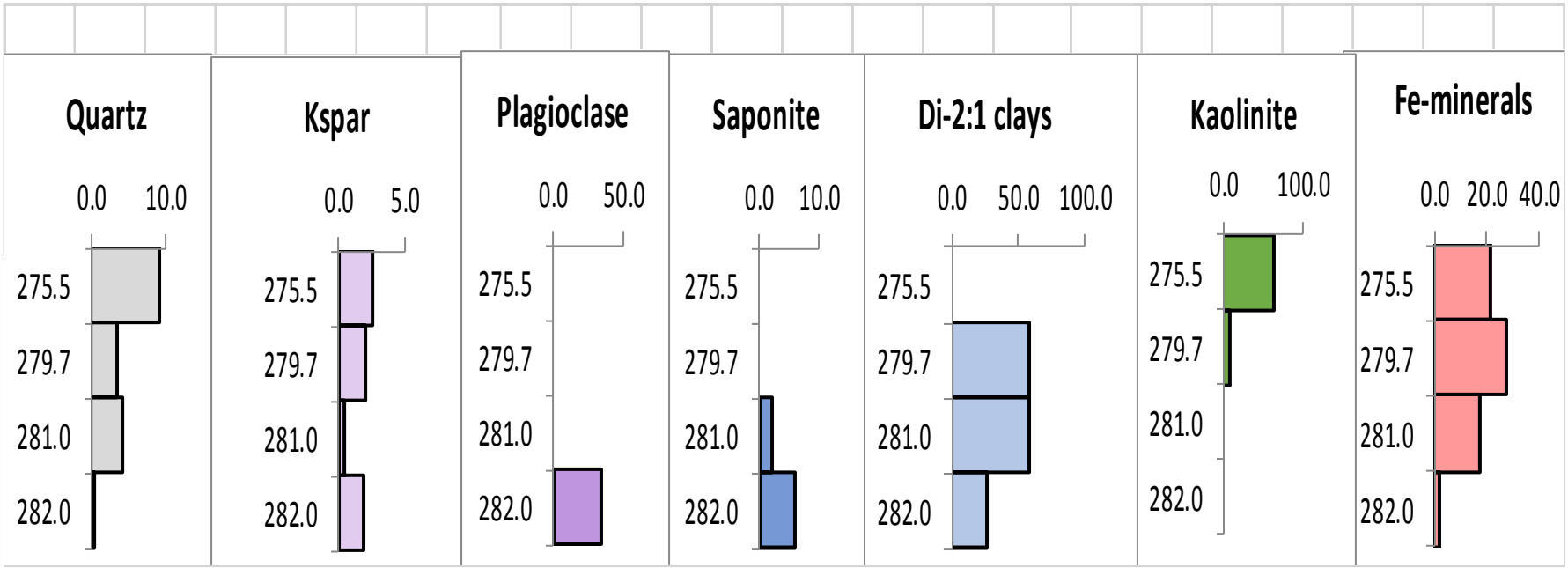
Note: The data presented has not been published yet

Weathering profiles on the Ediacaran basalts

Bulk rock XRD of basalt weathering



Mineral trends in the basalt weathering zone



Key references to mass balance calculations

- Brimhall G.H. and Dietrich W.E. (1987) Constitutive mass balance relations between chemical composition, volume, density, porosity, and strain in metasomatic hydrochemical systems: Results on weathering and pedogenesis. Geochemica et Cosmochemica Acta 51, 567-587.

- Brimhall G.H., Lewis C.J., Ague J.J., Dietrich W.E., Hampel J., Teague T. and Rix P. (1988) Metal enrichment in bauxites by deposition of chemically mature aeolian dust. Nature 333, 819-824.

Principle of mass balance calculation

Parent rock			Uncompacted weathered rock			Compacted weathered rock			Definitions
Mass		Volume	Mass		Volume	Mass		Volume	
				pores					**ROCK:**
Y									
		V			V			gV	Strain (fraction of volume)
			fY			fY			$\varepsilon_{iw} = g - 1$
a	mobile								
			b			b			Mass strain (fraction of mass)
X	inert		X			X			$\mu_{iw} = (X+fY)/(X+Y) - 1$
conc i	$c_{ip}=X/(X+Y)$			$c_{iw}=X/(X+fY)$			$c_{iw}=X/(X+fY)$		**MOBILE ELEMENT:**
density	$\rho_p = (X+Y)/V$			$\rho_w=(X+fY)/V$			$\rho_w=(X+fY)/gV$		Mass transport function
conc j	$c_{jp} = a/(X+Y)$			$c_{jw}=b/(X+fY)$			$c_{jw}=b/(X+fY)$		$\tau_{jw} = b/a - 1$

$$\varepsilon_{iw} = (\rho_p C_{ip}/\rho_w C_{iw}) - 1$$

volume strain mass

$$\mu_{iw} = (C_{ip}/C_{iw}) - 1)$$

$$\tau_{jw} = (\rho_w C_{jw} / \rho_p C_{jp})*(\varepsilon_{iw} + 1) - 1$$

mass transport

$$\tau_{jw} = (C_{jw}\, C_{ip}/C_{jp}\, C_{iw}) - 1$$

Mass balance calculation for the Ediacaran basalt paleosol

MASS BALANCE		Strain from inert elements εiw			Transport of mobile major elements Tjw									
4529	6,5 m	Zr	Ti	Nb	Al	Si	Fe	Mg	Na	Ca	K	P	Mn	Ti
4529-4	275.5	-0.51	-0.36	-0.57	-0.10	-0.41	-0.21	-0.92	-0.98	-0.98	-0.73	-0.86	-0.97	-0.23
4529-3	279.7	-0.54	-0.07	-0.61	-0.37	-0.45	0.02	-0.84	-0.98	-0.95	-0.64	-0.91	-0.93	-0.51
4529-2	281.0	0.15	0.22	0.16	-0.06	0.30	0.59	0.34	-0.95	-0.23	0.45	-0.36	-0.32	-0.05
4529-1	282.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Transport of mobile trace elements

Ba	Be	Co	Cr	Cs	Cu	Ga	Hf	Mo	Ni	Pb	Rb	Sn	Sr	Ta	Th	U	V	W	Zn	B
-0.76	0.73	-0.26	-0.40	-0.43	62.56	-0.35	-0.05	0.15	-0.14	0.06	-0.57	-0.07	-0.92	-0.11	0.65	4.20	-0.11	-0.96	-0.91	0.49
-0.74	0.49	-0.36	-0.92	-0.37	1.07	-0.22	0.06	-0.23	-0.37	0.11	-0.53	-0.03	-0.78	0.10	0.96	1.88	-0.85	-0.98	-0.93	0.50
-0.76	0.73	1.15	-0.19	0.97	11.68	0.19	0.06	-0.23	0.82	-0.67	0.55	0.02	-0.47	-0.27	-0.15	0.02	-0.68	-0.89	-0.65	0.31
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Transport of REE

La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Sc	Y	LREE	HREE	SUM
-0.28	-0.21	-0.31	-0.46		-0.58	-0.64	-0.69	-0.74	-0.77	-0.78	-0.82	-0.81	-0.83	-0.83	-0.30	-0.86	-0.13	-0.61	-0.38
0.40	0.14	0.05	-0.16		-0.26	-0.40	-0.47	-0.51	-0.50	-0.47	-0.49	-0.43	-0.38	-0.35	-0.49	-0.67	1.13	-0.12	0.47
-0.43	-0.45	-0.38	-0.42		-0.29	-0.40	-0.35	-0.30	-0.34	-0.22	-0.26	-0.21	-0.22	-0.29	0.05	-0.38	-0.39	-0.22	-0.30
0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Summary

- Techniques of mass balance calculation in soil profiles have been modified for the compacted paleosols.
- This approach produced a consistent and valuable data set for an Ediacaran paleosol developed on basalt.
- This modification may turn practical also for Recent soils, as it avoids the bulk density measurements.