Saadi F., Boudad L., Richard M., Berger J.-F.

HIGH-RESOLUTION MORPHO-SEDIMENTARY AND PALEOENVIRONMENTAL EVOLUTION OF WADI AKKA (DRÂA BASIN, MOROCCO) FROM LATE PLEISTOCENE TO HOLOCENE

Alpine and Mediterranean Quaternary, 38 (2), 2025, 85-109 https://doi.org/10.26382/AMQ.2025.05

ISSN 2279-7335

Supplementary Material

METHODOLOGY 1/3

Chronology

Optically Stimulated Luminescence (OSL) and post-Infrared Infrared Stimulated Luminescence ($pIRIR_{290}$) Dating

OSL and $pIRIR_{290}$ are trapped charge dating methods that allow dating the last bleaching event, i.e., the last exposure to light of quartz (OSL) and feldspar ($pIRIR_{290}$) grains before deposition in a sedimentary layer (see details in Aitken, 1998). Both quartz and feldspars are able to record a dose of ionising rays coming from the sedimentary environment of the sample (from the decay of isotopes from the uranium, U, and thorium, Th, decay chains, as well as potassium, K), and the cosmic rays. The dose stored in the mineral is called the equivalent dose (D_e, in Gray, Gy) and is obtained by stimulating with light the sample, which will in turn emit light (the luminescence signal). To obtain the D_e, a dose response curve (DRC) is constructed by measuring the natural luminescence signal on an aliquot of a given sample, and regenerating this signal by irradiating the same aliquot at increasing doses using the single-aliquot regenerative-dose protocol (SAR, Murray & Wintle, 2000) The D_e is obtained by interpolation on the DRC. The age is obtained by dividing the D_e by the dose rate (D_a, in $Gy{\cdot}a^{-1}$), i.e., the dose of radiation emitted per year in the surrounding of the sample and the sample itself (applicable for feldspars) and that corresponds to the sum of alpha, beta, and gamma rays, with the contribution of the cosmic rays. Three protocols were used in this study. First, the OSL SAR protocol was applied to quartz from multi-grain aliquots (Tab. S1). Considering that the OSL signal of sample AKKA2-OSL1 was close to saturation, the $pIRIR_{290}$ SAR protocol was applied to K-feldspars from multi-grain aliquots for this sample (Tab. S2). For the three other samples, OSL multigrain analyses showed that some aliquots were saturated or close to saturation, and/or high OD values were obtained (see details in the main text). We thus performed OSL single grain analyses on quartz from samples AKKA2-OSL2, 3 and 4 (Tab. S3).

Step	Treatment
1	Given dose
2	Preheat (240°C for 10 s)
3 (Lx)	Green stimulation for 100 s at 125°C
4	Given test dose
5	Cutheat (200°C for 0 s)
6 (Tx)	Green stimulation for 100 s at 125°C
7	Return to 1

Tab. S1 - OSL SAR protocol applied to quartz from multi-grain aliquots.

Step	Treatment
1	Given dose
2	Preheat (320°C for 60 s)
3	Infrared stimulation for 200 s at 50°C
4 (Lx)	Infrared stimulation for 200 s at 290°C
5	Given test dose
6	Preheat (320°C for 60 s)
7	Infrared stimulation for 200 s at 50°C
8 (Tx)	Infrared stimulation for 200 s at 290°C
9	Optical draining (infrared stimulation for 100 s at 325°C)
10	Return to 1

Tab S2 - $pIRIR_{290}$ SAR protocol applied to feldspars from multi-grain aliquots.

Saadi F., Boudad L., , Richard M., Berger J.-F.

HIGH-RESOLUTION MORPHO-SEDIMENTARY AND PALEOENVIRONMENTAL EVOLUTION
OF WADI AKKA (DRÂA BASIN, MOROCCO)
FROM THE RECENT PLEISTOCENE TO THE HOLOCENE

Alpine and Mediterranean Quaternary, 38 (2), 2025, 85-109 https://doi.org/10.26382/AMQ.2025.05

ISSN 2279-7335

Supplementary Material

METHODOLOGY 2/3

Step	Treatment
1	Given dose (for N, dose = 0)
2	Preheat at 240°C for 10 s
3 (L_x)	SG Green stimulation at 125°C for 1 s
4	Given test dose
5	Cutheat at 200°C for 0 s
6 (T_x)	SG Green stimulation at 125°C for 1 s
7	Return to 1

Tab. S3 - OSL SG SAR protocol applied to quartz.

	OSL2	OSL3	OSL4
Number of grains measured[1]	1000	1000	1000
Number of grains that passed criteria[2]	63	21	21
Number of rejected grains[3]	37	4	5
- No intersection	20	1	2
- Extrapolated grains	0	1	0
- Saturated grains ($D_e > 2*D_0$)	17	1	3
- Negative D_e	0	1	0
Accepted grains[4]	26	17	16

Tab. S4 - Statistics on the selected single grains. [(1)]Total number of individual quartz grains measured using the SAR protocol; [(2)]Number of grains that provided a luminescence signal passing the selection criteria; [(3)]Among the grains that passed criteria, those for which no intersection was reached, those for which the L_n/T_n signal was higher than the highest regenerated point (extrapolated grains), those for which the D_e was higher than two times D_0 (Wintle & Murray, 2006) and those for which a D_e < 0 was obtained.

Saadi F., Boudad L., , Richard M., Berger J.-F.

HIGH-RESOLUTION MORPHO-SEDIMENTARY AND PALEOENVIRONMENTAL EVOLUTION
OF WADI AKKA (DRÂA BASIN, MOROCCO)
FROM THE RECENT PLEISTOCENE TO THE HOLOCENE

Alpine and Mediterranean Quaternary, 38 (2), 2025, 85-109 https://doi.org/10.26382/AMQ.2025.05

ISSN 2279-7335

Supplementary Material

METHODOLOGY 3/3

Principal Component Analysis (PCA)

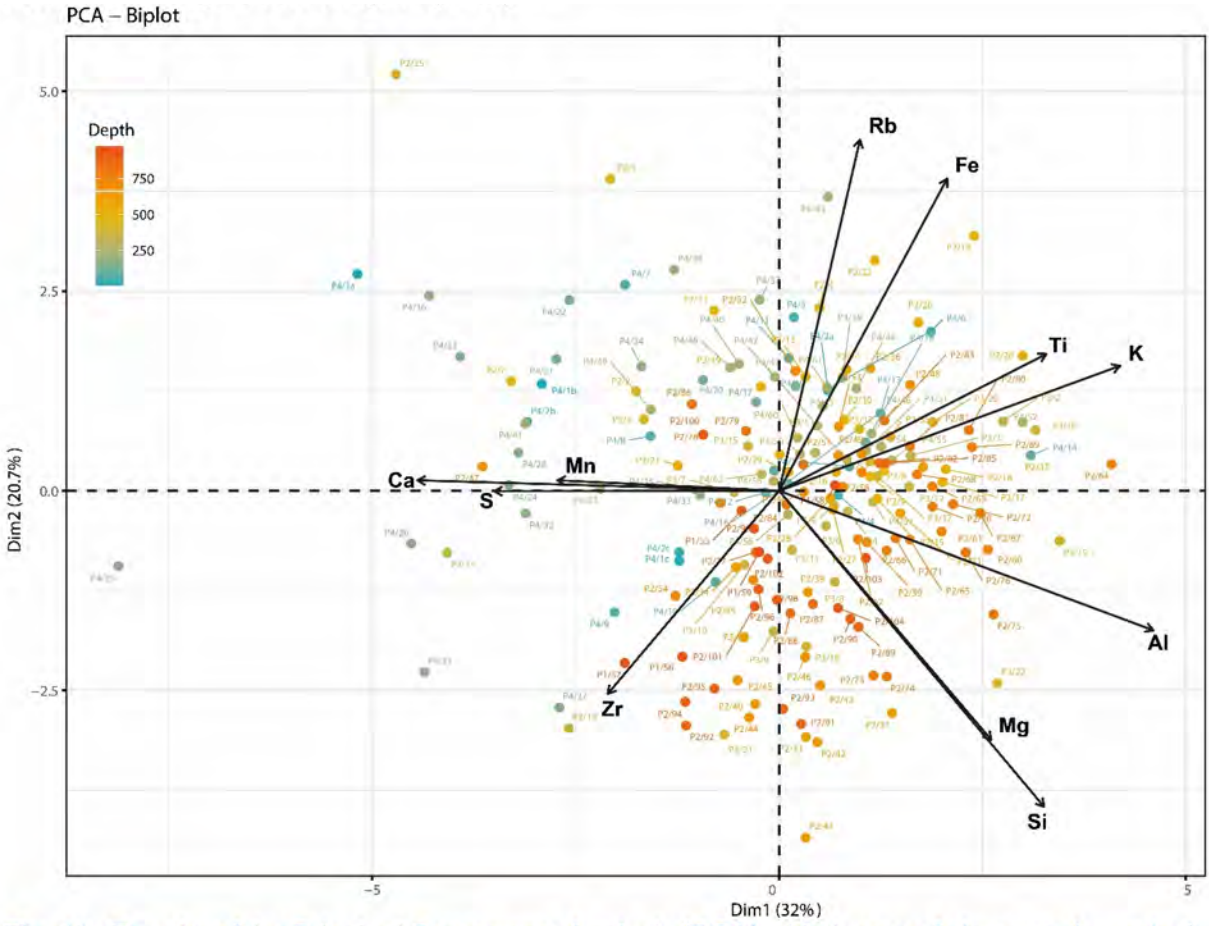


Fig. 11 - Results of the Principal Component Analysis (PCA) with the set of elements (samples).