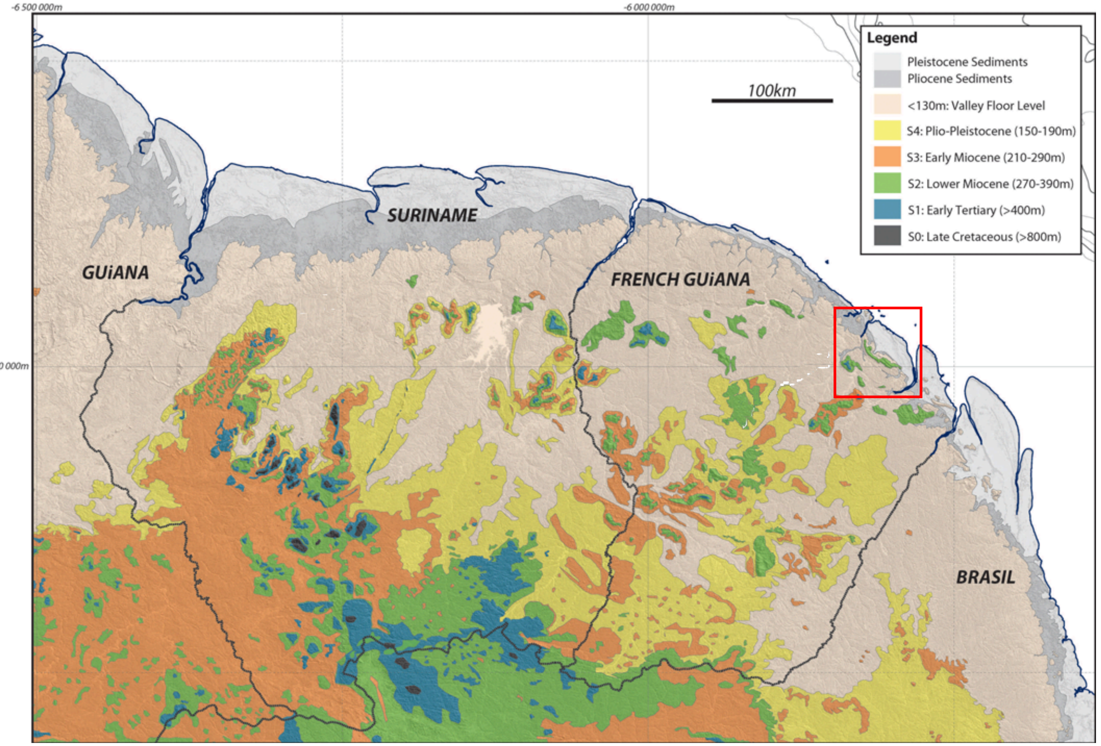
(U-Th-Sm)/He dating of supergene Fe-duricrusts in NE French Guiana: implications of a multiproxy approach

Beatrix Heller[1,2]*, Silvana Bressan-Riffel[3], Cécile Gautheron[1], Thierry Allard[2], Guillaume Morin[2], Jean-Yves Roig[4], Renaud Coueffe[4]

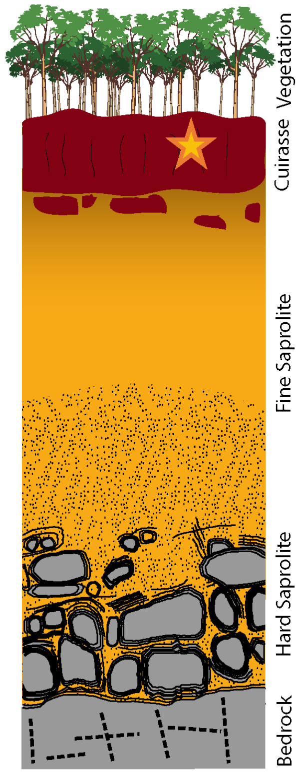
[1]Université Paris-Saclay, CNRS, GEOPS, France; [2]Sorbonne University, CNRS, France;
[3]UFRGS, Federal University of Rio Grande do Sul, Brazil; [4]BRGM France
*: beatrix.heller@universite-paris-saclay.fr | www.reca.u-psud.fr

Motivation

- **Laterites** are deep, stratifed weathering soils.
- Top layer contains often a **Fe-duricrust** ("cuirasse"), composed mainly of iron oxides and oxyhydroxides (hematite and goethite).
- Guiana Shield is **tectonically stable** and in tropical latitudes since Cretaceous.
- Low-T thermochronological data from French Guiana basement rocks indicates near surface conditions since 90 Ma[1].
- Different models exist on the landscape evolution and age data of **paleosurfaces** are very rare.
- Direct dating of iron minerals allows information on timescales and mechanisms of **weathering** and paleosurface evolution [2].
- Dating is analytically challenging due to the multiple reopening of the system due to percolating fluids and the microcrystalline character of the material



Map of the Guianas compiled by [3] presenting the major topographic planation surfaces identified in the bibliography. The red square indicates the working area

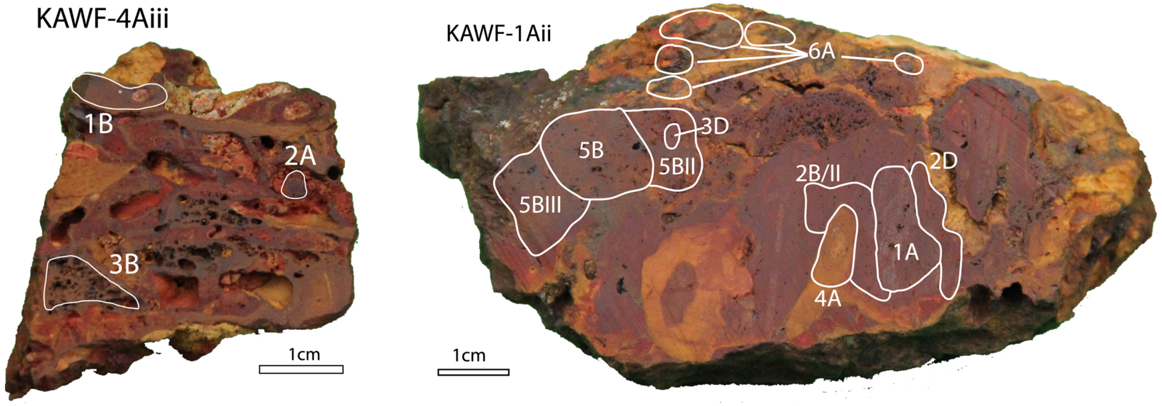


Sketch of a lateritic profile, star marks the Fe-duricrust

Samples and Methods

Fe-duricrust samples from two sites in NE French Guiana:

- Kaw mountain ridge
  - elevation ~300m at top, samples from top and slopes
  - duricrust tilted to N and S
  - Paleomagnetism age of 50±10 Ma [4]
- Mont Baduel
  - Top~100m, sample from 65m
  - Paleomagnetism age of 40±20 Ma [4]
- Samples are very heterogeneous at large and small scale



Examples of two samples from Kaw with marked generations separated for analyses

Generation characterization:

- Classification of same age (supposed) generations and separation by microdrilling

Analyses

- (U-Th-Sm)/He dating
- X-Ray powder diffraction
- Scanning electron microscopy

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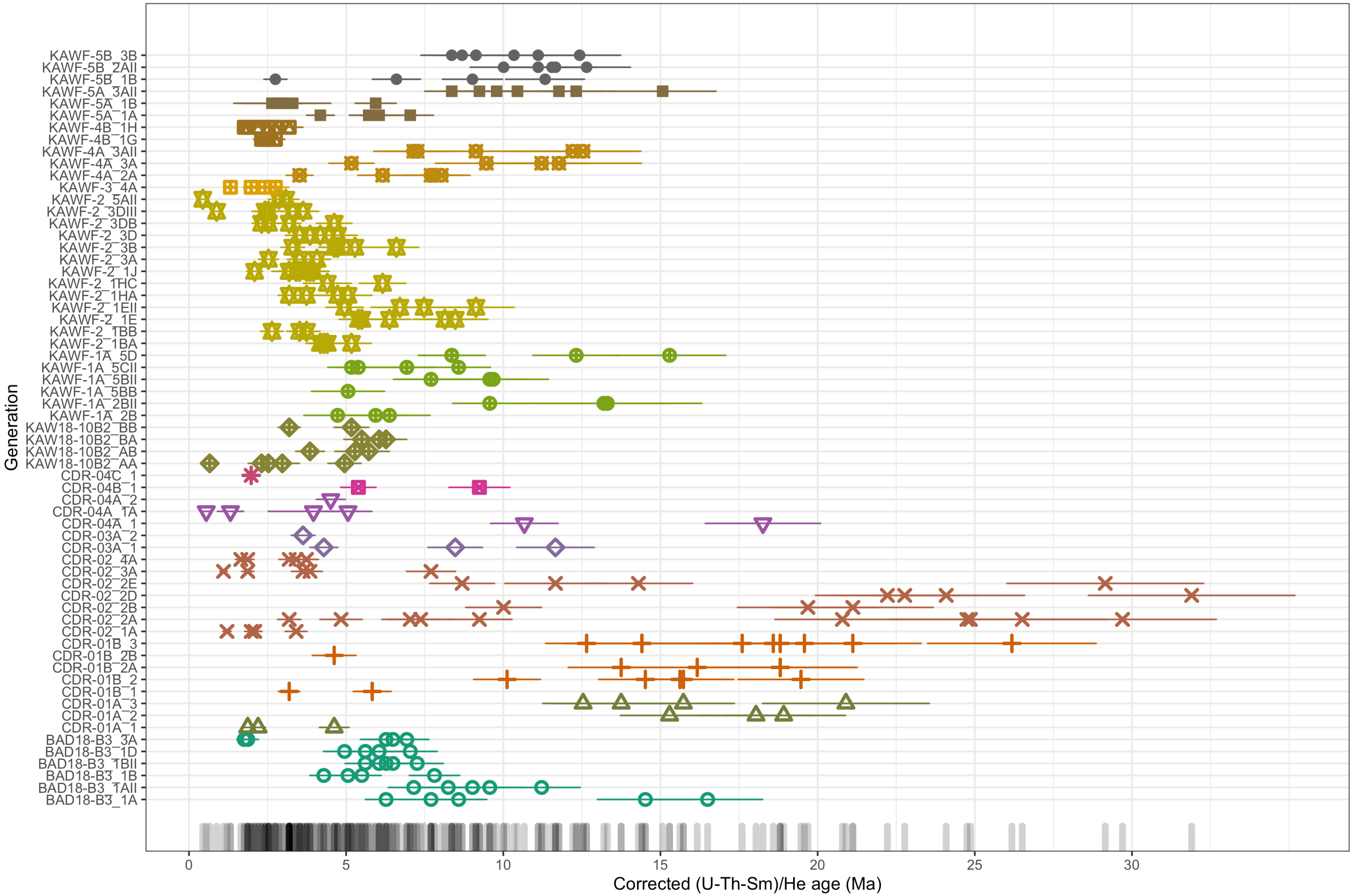
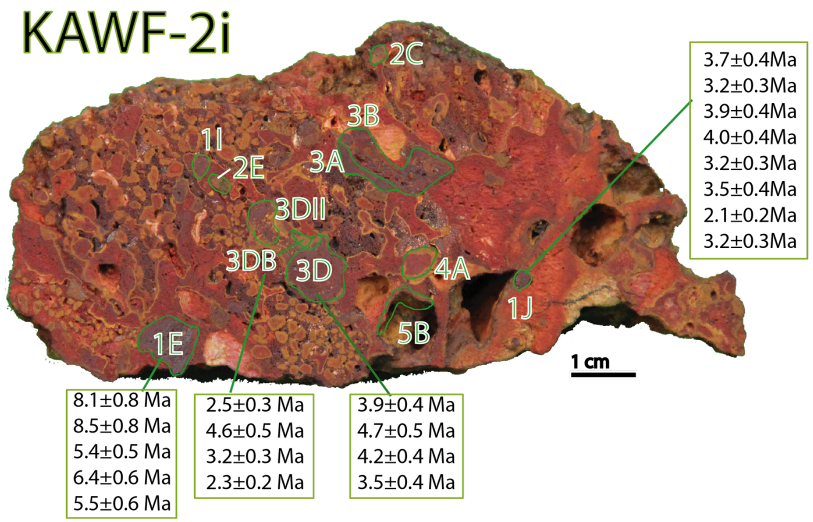
Results



Diffusion corrected (U-Th-Sm)/He ages(n=269) for each separated generation. Every symbol and colour corresponds to one sample. For KAWF- and BAD samples, generation "1" is supposed to be the oldest. The grey bars on the bottom indicate the data density.



Duricrust sample from Kaw with marked generations separated by microdrilling and corresponding diffusion corrected (U-Th-Sm)/He ages

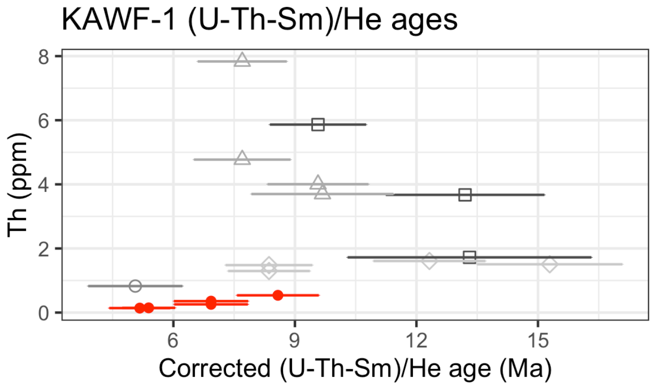
Age dispersion ?!

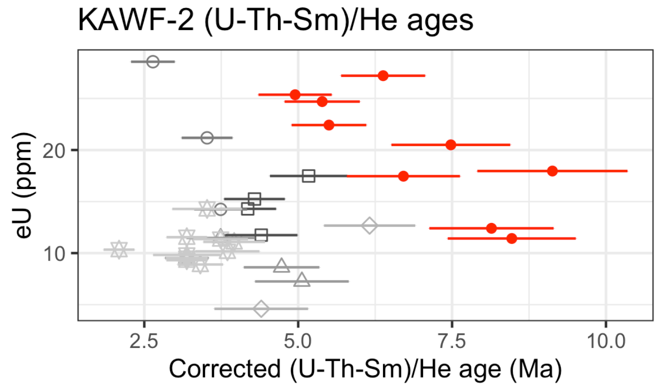
In most generations of our dataset, age dispersion exceeds analytical uncertainty

Are the dispersed ages meaningful or the result of phase mixing, Helium loss or inclusions?

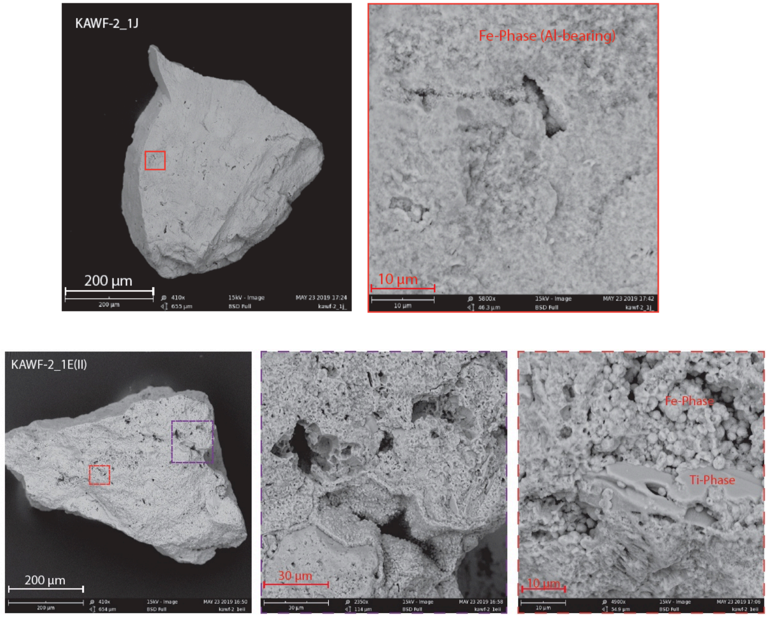
To answer this questions we do:

- detailed data analysis of every sample and generation
- mineralogical characterization of the samples
- geochemical analysis of the samples by solution- and LA-ICP-MS might allow detection of actinide rich inclusions or intergrowth of different phases or generations





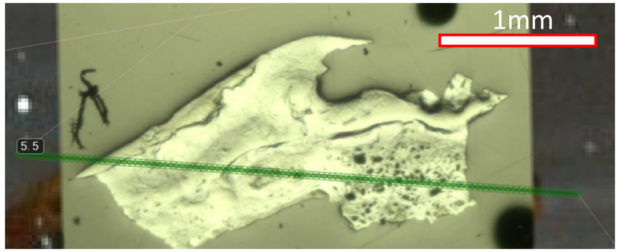
(U-Th-Sm)/He ages versus Th (left) and effective Uranium (eU=U+0.235*Th). Every symbol corresponds to one generation. The red generations are examples where age correlates well with Th or eU. Note that this is not the case for the other generations.



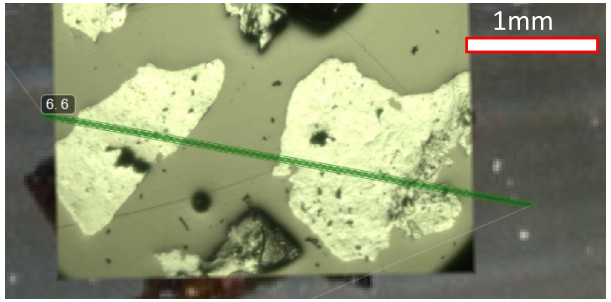
Back scattered electron images taken by scanning electron microscopy of grains from two generations (1J and 1E from the sample KAWF-2 shown below). The coloured boxes on the grains correspond to the zoomed detail images. Phases were determined by EDS spot analysis.

LA-ICP-MS grain transects

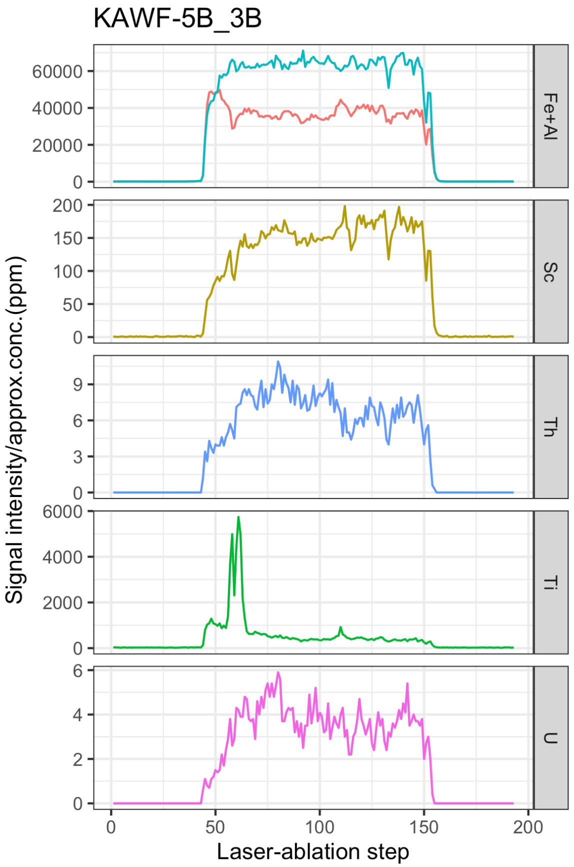
KAWF-5B_3B

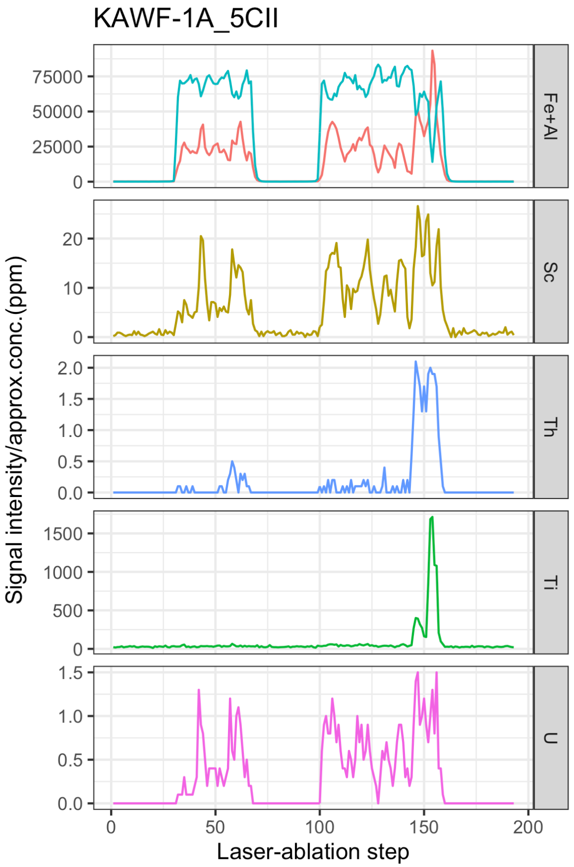


KAWF-1A_5CII



Reflected light photographs of grains of samples KAWF-5B_3B (top) and KAWF-1A_5CII (bottom), analysed by LA-ICP-MS. The green lines show the transects presented on the left





LA-ICP-MS line transects through grains of two samples. The Y-axis shows the signal intensity along the transect which for the trace elements corresponds approximately (!) to the concentration in ppm. Sample KAWF-5B_3B (right) is very homogeneous for most main and trace elements (Fe=blue, Al=red), U and Th show a similar profile. Sample KAWF-1A_5CII is more heterogeneous and Fe (blue) and Al(red) show an anticorrelation. While Sc and U show profiles similar to Al, Th is distributed differently and shows a profile similar to Ti (not the case in sample KAWF-5B_3B).

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[4] Théveniaut, H., and Freyssinet, P. (2002): Timing of lateritization on the Guiana Shield: synthesis of paleomagnetic results from French Guiana and Suriname. Palaeogeography, Palaeoclimatology, Palaeoecology (178) 91-117.

