Magnetic properties of cave sediments at Gran Dolina in Sierra de Atapuerca (Burgos, Spain)

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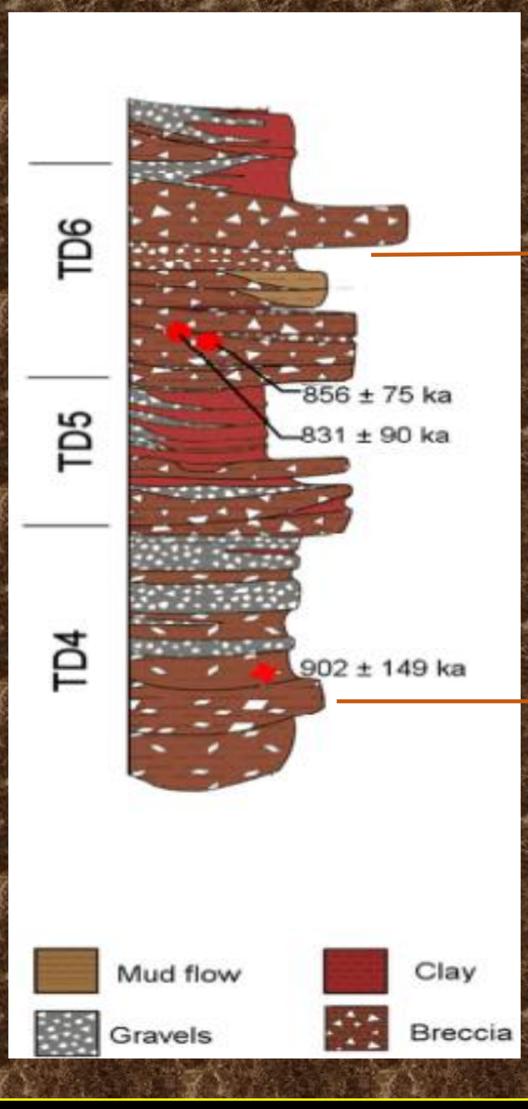
1. MOTIVATION

- Sierra de Atapuerca represents one of the most important archaeological and paleontological sites of Middle and Early Pleistocene age in Europe;
- Gran Dolina includes layers of hominid occupation (TD10 and TD6).

Through the iron oxides I will try to decode and better understand the paleoenvironment of the period of time when there is a hominid presence (and maybe understand why there is not it in other levels ...).

2. STRATIGRAPHY



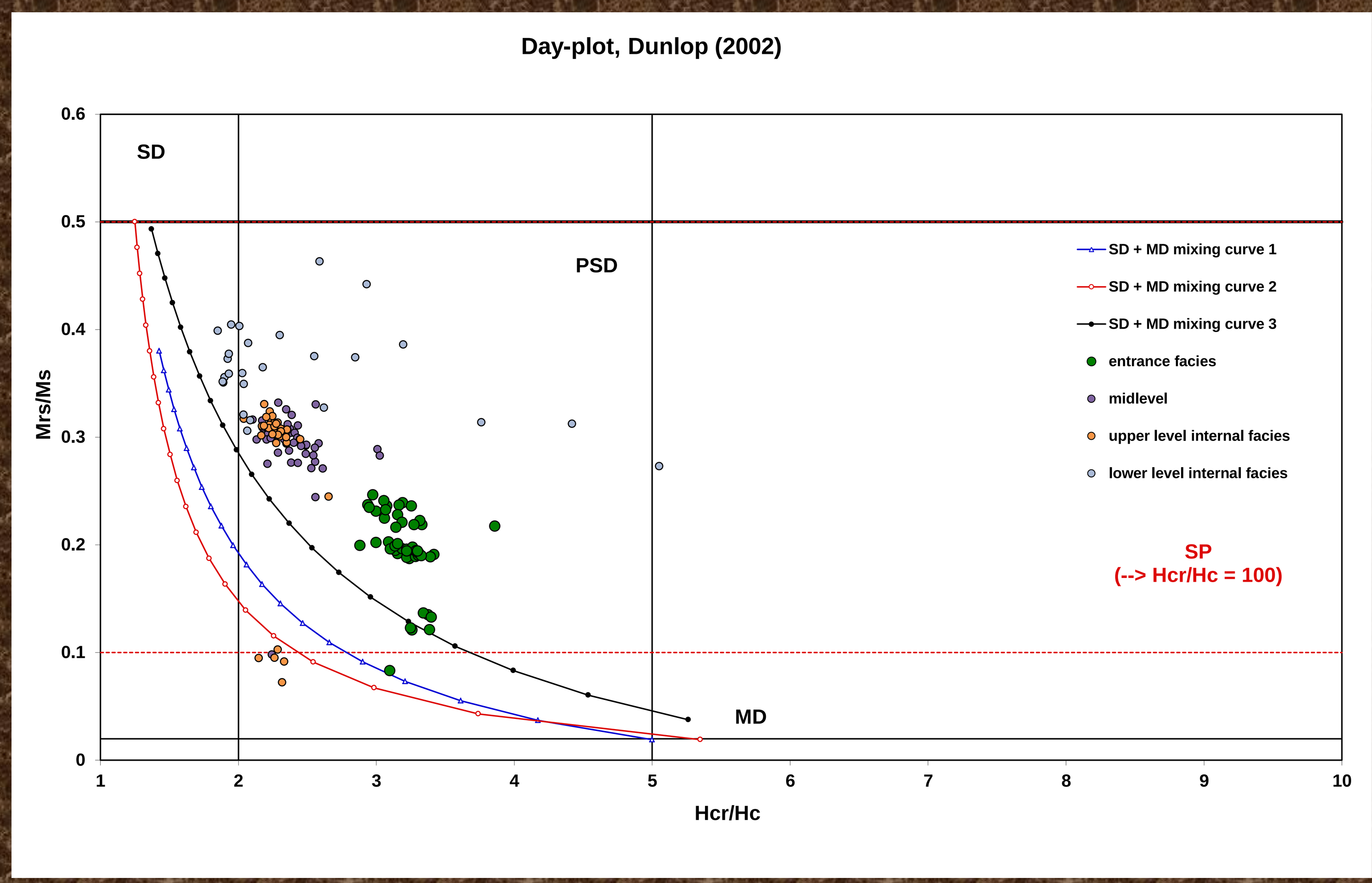
800.000 years

970.000 years

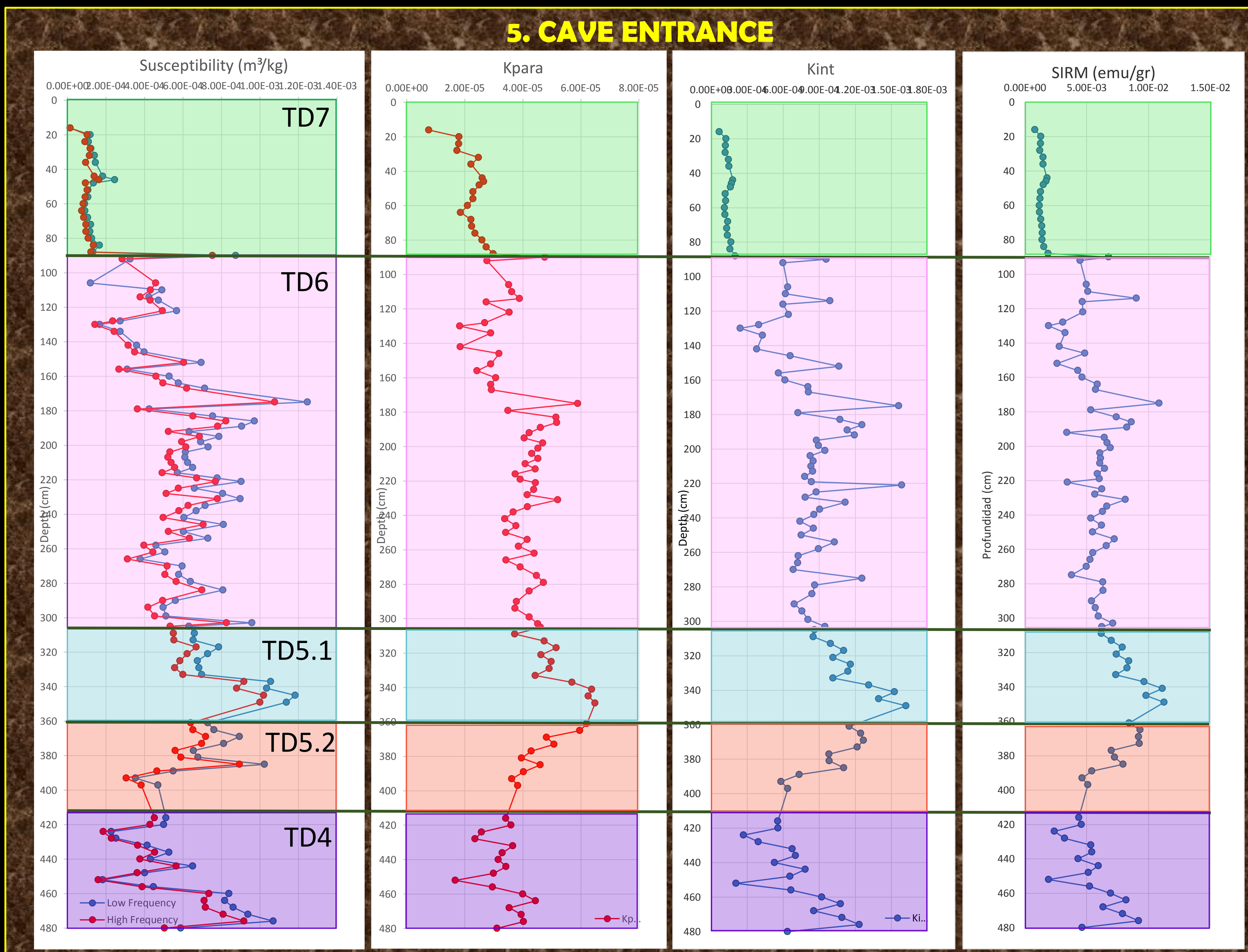
3. EXPERIMENTS

- Bulk susceptibility and frequency dependence to estimate the concentration of ferromagnetic grains near the SD/SP boundary;
- Hysteresis cycles in order to obtain the Day Plot and distinguish the magnetic grain size;
- IRM acquisition and demagnetization with Lowrie test to identify magnetic minerals;
- Thermomagnetic curves to identify the minerals and if during the heating some minerals was created or destroyed;
- ARM a 0.50 Gauss to obtain the King Plot to study the grain sizes;
- First Order Reversal Curve – FORC.

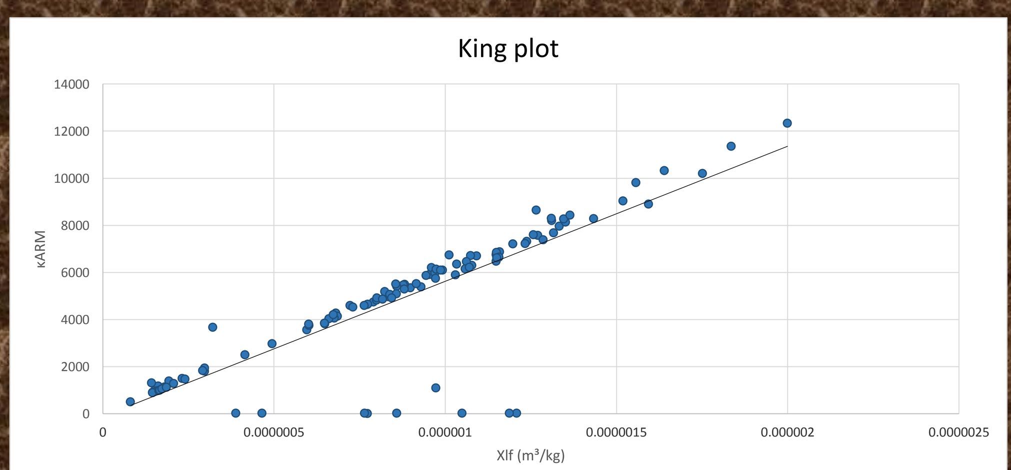
4. DAY PLOT



5. CAVE ENTRANCE

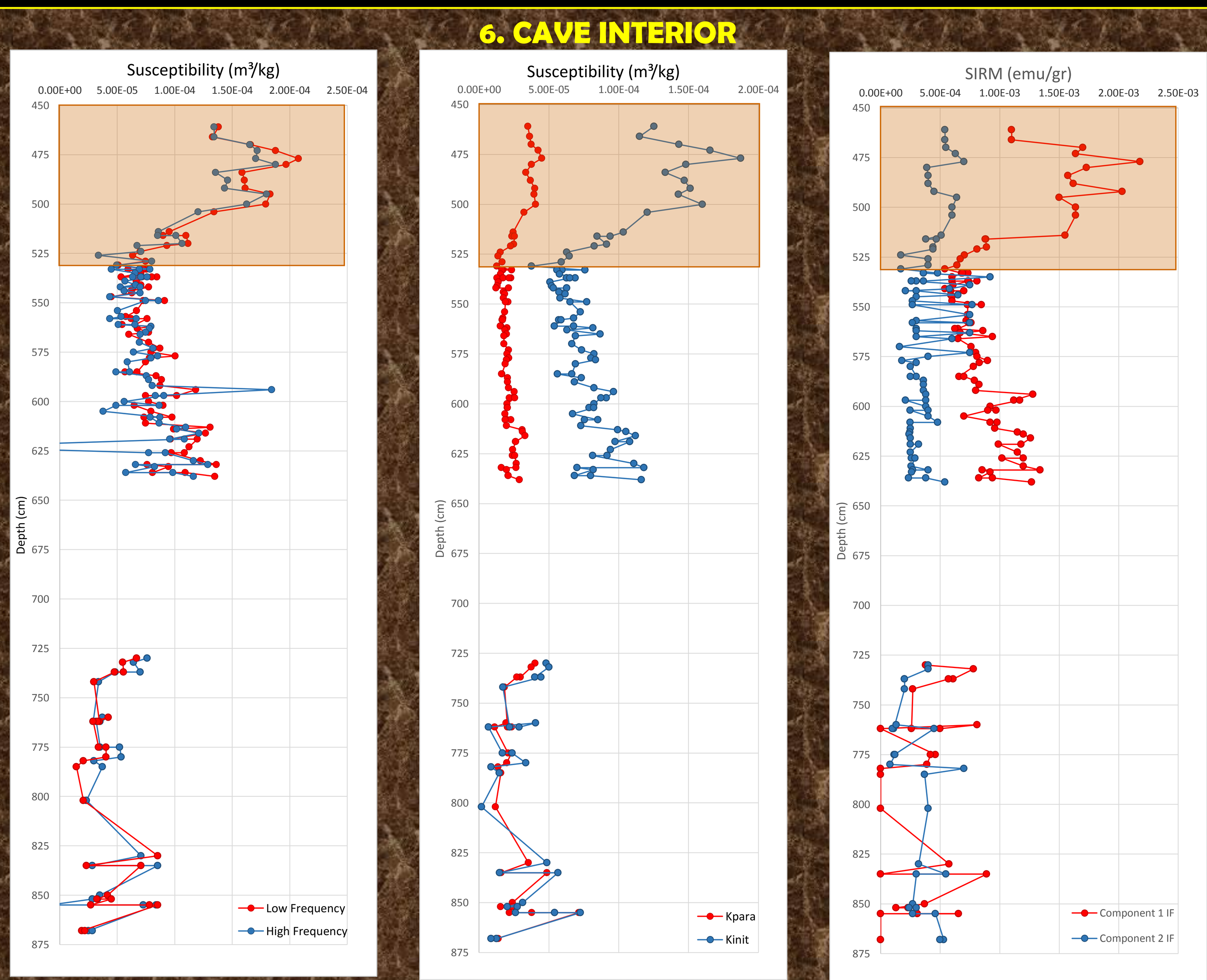


The profile of frequency dependence of χ is used in order to estimate the concentration of ferromagnetic grains near the SD/SP (single domain/super-paramagnetic) boundary and the measurements of paramagnetic susceptibility quantifying the contribution of paramagnetic minerals to the bulk χ. So in this case, we can see a particular change in the TD7-TD6 boundary; it coincides with a climate change, infact in the top of this level we find a mayor human presence due to the warm weather. In the right side we have the profile of Saturation Isothermal Remanent Magnetization (SIRM), it represents the maximum remanence acquired by deliberate exposure of a material to a steady field at a given temperature. Its values for magnetite rapidly drop with increasing grain size from single domain through pseudosingle domain to multidomain grains. So, we can infer that the profile of this parameter indicates also the increasing of the grain size in the warm period.

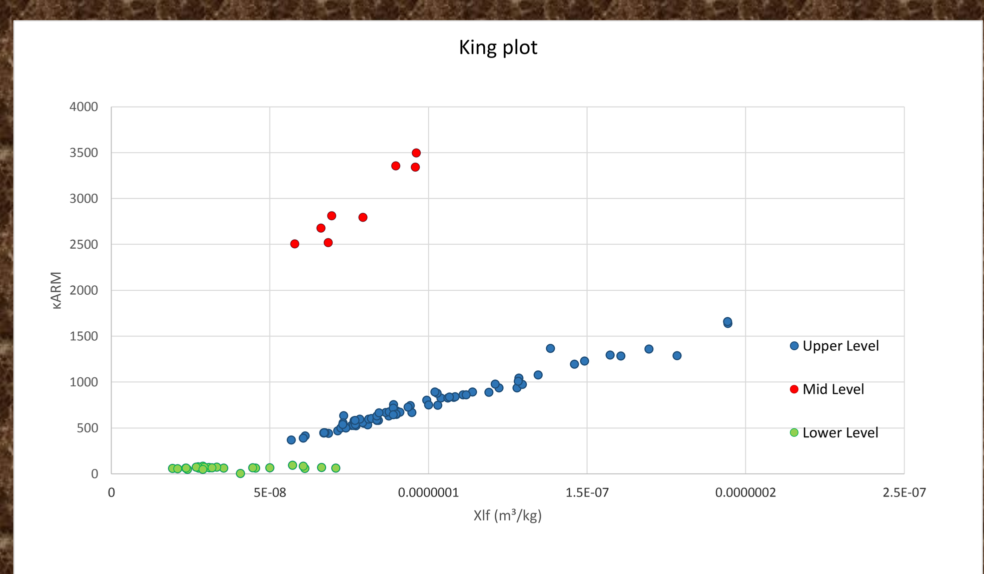


Since that we have samples where the dominant magnetic mineral is magnetite, the King Plot provides a means of assessing grain sizes. In this case, we have a typical distribution for small grains (0.1µm).
There are also some samples of mayor size (≈200µm), they are deeper.

6. CAVE INTERIOR



Also in this case we have the profiles of the frequency dependence of the susceptibility and the paramagnetic susceptibility obtained from the hysteresis cycle. We can see in both profiles that there is a change in the values of the susceptibility at depth of 515cm, probably due to the different energy of river's flow. In the right side we have the profile of SIRM, thanks to which we can infer that there is also a decreasing in the gran size in the shallower depth, maybe also connected with a different energy of river's flow. This decreasing is more evident for the component of low coercivity, the magnetite.



In the case of cave interior, we can distinguish three different families of grain sizes:
- Upper Level: grain sizes of dimension 1.0µm;
- Mid level: grain sizes of dimension 0,1µm;
- Lower Level: grain sizes of dimension 200µm.

7. CONCLUSIONS

CONCENTRATION of the magnetic minerals changes in the facies interior that probably it can be attributed to changes in the water flow circulating in the cave (either flow intensity, the particles that it carried, etc.), while in the cave entrance changes in the different layers with a kind of continuity;
COMPOSITION of the magnetic minerals is principally dominated by magnetite and hematite, where the first represent the mineral of low coercivity and the second of the high coercivity;
GRAIN SIZE of the magnetic minerals particles is more or less constant for the cave entrance sediments, but it changes in the cave interior sediments, where we can distinguish the larger dimensions in the lower level, while the smallest grain size is found in the mid level and the upper level with intermediate size.

8. REFERENCES

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