HOW WRONG CAN YOU BE in interpreting AFTA data?

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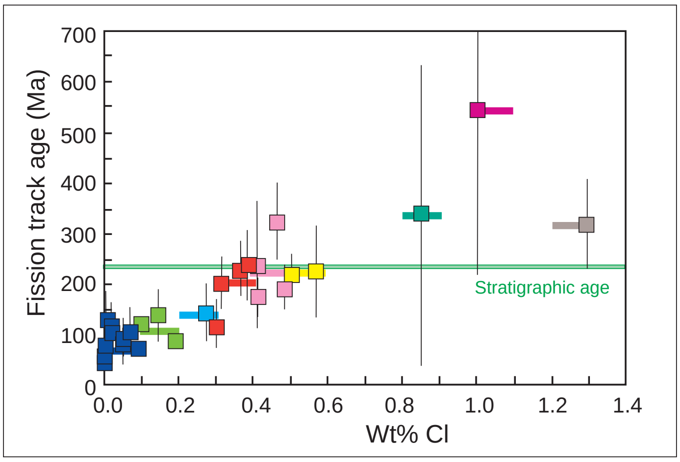
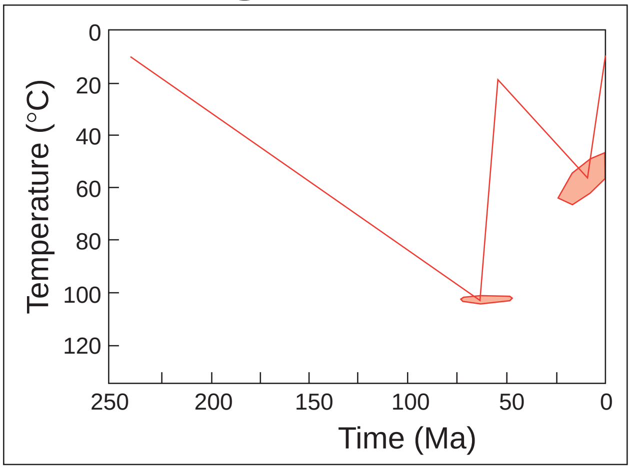
Converting raw fission track data into thermal history solutions is at the core of the AFTA® (Apatite Fission Track Analysis) technique. To ensure these solutions are as precise and accurate as possible, it is essential to use the most reliable algorithms for annealing kinetics, and to allow for compositional influences on annealing rates.

It is also important that the basic data are collected in a way that allows these aspects of the technique to be taken into account. The examples shown below illustrate the possible errors that can be made in failing to allow for these **critical** factors.

This plot shows some results from an outcrop sample of Triassic age. Fission track ages in individual apatite grains are plotted as a function of chlorine content. Low-Cl grains are more easily annealed (lower measured ages) than their high Cl counterparts (higher ages). The result is a significant spread in single grain ages within a **single** sample. It is vital that this effect is understood and explicitly included in recovering the thermal history solution from fission track data.

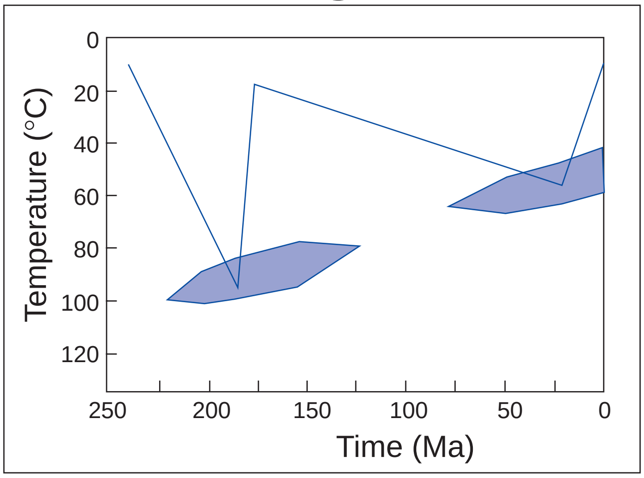


On the right track ....



A procedure that allows for accurately collected data (fission track age and length data and their variation with Cl content) will show this sample began to cool from a maximum paleotemperature of ~100°C sometime between 75 and 50 Ma which is consistent with geological evidence for this region. Can you afford to be wrong by ~100 Ma?

On the wrong track ...



An analysis that ignores the profound effects of apatite compositional variation would not recognise that the fission track ages were measured from Cl-rich grains, while track lengths were from Cl-poor grains. The result is a maximum paleotemperature between 225 and 125 Ma which makes no geological sense for this region.

It's easy to get it wrong ... why risk it?

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HOW WRONG CAN YOU BE in interpreting VR data?

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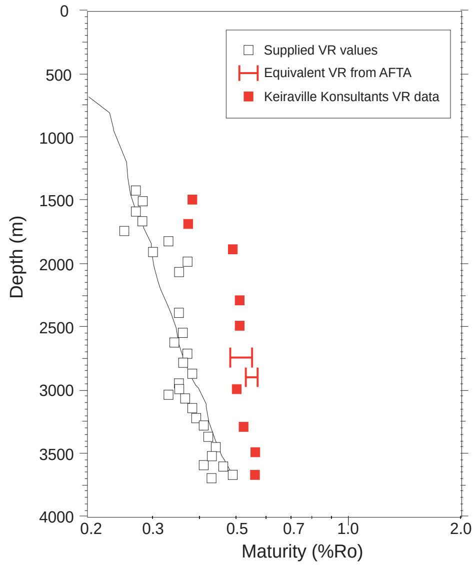
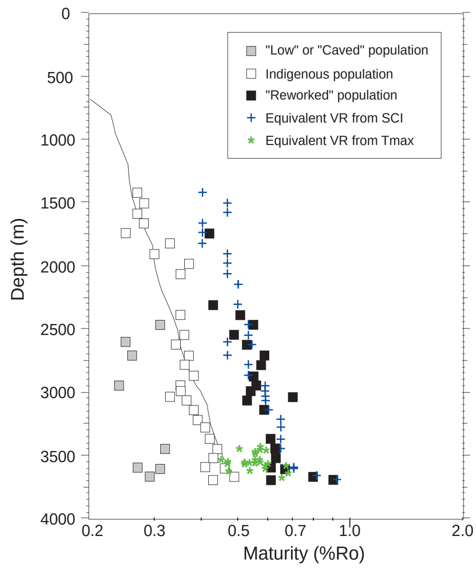
VR data from different laboratories vary appreciably in quality and reliability. Experience suggests that attribution of modes - e.g. caved, indigenous and re-worked, solely from the data is often erroneous. VR data produced on the basis of identifying the indigenous vitrinite population on petrographic grounds provides the most reliable data.

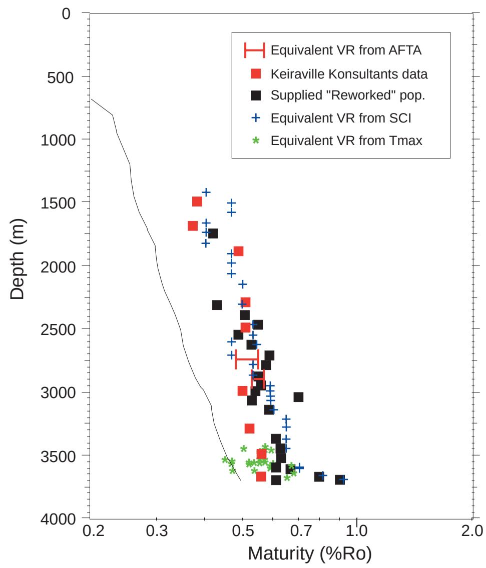
The results on the right are from a recent study of an offshore well. VR data supplied by a client (open squares) and new VR data generated for our report (red), are plotted against depth. Also shown are ranges of equivalent VR levels derived from AFTA in two samples from this well. The solid line shows the VR profile predicted by the "Default History", i.e. the profile expected if samples throughout the section are currently at their maximum temperature since deposition. There is a clear mis-match between the two VR datasets. While the original data suggest that all units throughout the well are currently at their maximum temperatures, the new VR data and the AFTA results suggest that most units have been hotter in the past.



In the full specification of the originally supplied vitrinite reflectance results, data were assigned to various populations by the analysts. Mean values of different populations within each sample are plotted here against depth. The solid line again shows the VR profile predicted by the "Default History". Also shown in this plot are equivalent VR values derived from SCI and Tmax values (both also from the original analyses). These equivalent VR values are consistently higher than the measured population assigned to the indigenous population, but very consistent with the population assigned to "re-worked" vitrinite. This suggests that values originally designated as the indigenous population are too low and that of the original dataset the VR values originally designated as "reworked", together with the SCI and Tmax values, provide the most reliable indication of true maturity levels in this well.



In this plot, the new VR data are shown in red, while "re-worked" vitrinite reflectance values from the well operator's original maturity study are shown as black squares. Equivalent VR values derived from SCI data and Tmax data (both also taken from the operator's original maturity study) are shown in blue and green, respectively. Also shown are ranges of equivalent VR levels derived from AFTA in the two samples from this well. There is clearly a high degree of consistency between all these values through the well, which confirms that these data provide the most reliable representation of true maturity levels in this well. The solid line again shows the VR profile predicted by the "Default History". All values plot well above the profile, suggesting that units throughout the well have been hotter in the past. Synthesis of all these data shows that maturity levels in this well are significantly higher than previously thought.



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