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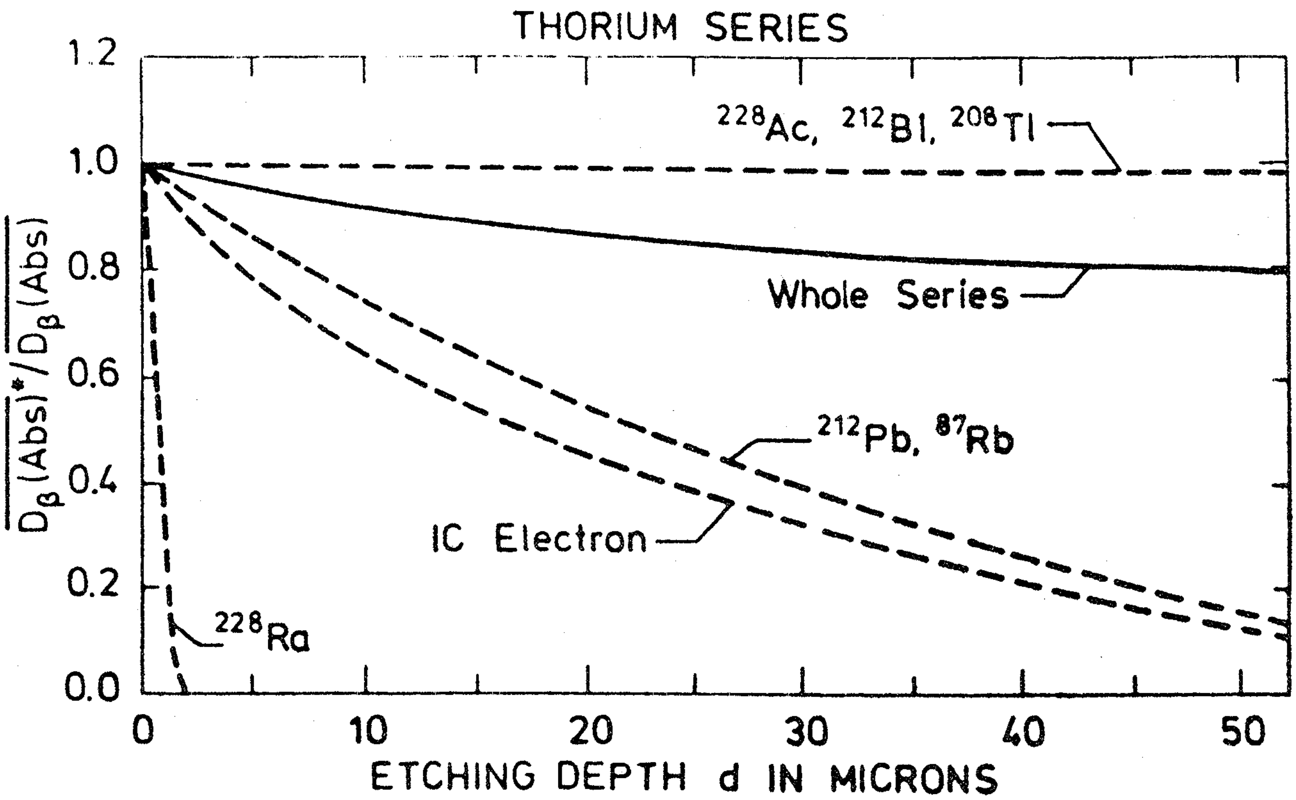
FIGURE 3



A SWEDISH VITRIFIED FORT: DATING BY CONVENTIONAL TL

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(1) Introduction.

This paper gives an account of measurements of conventional TL on samples discussed in a previous publication. (Wright 1979a). In that paper dating was carried out by the predose method on material from a Swedish vitrified fort. In the present work the samples and their preparation were as in the earlier paper. The standard procedure has been followed, including plateau test, correction for supralinearity, check of parallel slope criterion, and check for fading.

(2) Results.

(a) Samples treated in dilute HCl only. 4e, 8a, 8b, 12, 14.

This treatment removed the limestone but feldspar was retained with the quartz, (feldspar 17.6%, quartz 82.4%). The TL behaviour was normal, giving plots of which Fig. 1 is typical (sample 4e). The TL was large, and the tests were satisfactory; for sample 4 the fading in two months was about 16% consistent with feldspar being the main source of the TL (Fleming 1976). The archaeological dose for sample 8 (350 μ) was however equivalent to a β-irradiation time of 220 min. compared with the predose result of 90 min.

This large difference is due at least in part to the presence of feldspar in the samples. Chemical analysis showed that 97-99% of the K_2O was present in the feldspar. The feldspar and quartz combined constituted about 0.5% of the total sample; there was about 2% brown flaky material, the remainder limestone. The β-dose rate within the feldspar grains is considerably higher than the mean dose to the quartz grains as deduced from the mean K_2O and U/Th content.

Recent work by Mejdahl et al (1979) shows that the β-dose rate due to K_2O within feldspar grains exceeds the mean rate to quartz grains in a manner which may provide the basis for a new method of TL dating. The feldspar dose rate increases with grain size, whereas the dose rate to quartz decreases with grain size, and the former becomes twice the latter for the compositions considered by Mejdahl at a grain size of 800 μ. In the present case the situation is extreme because of the low feldspar concentration in the total, so that many quartz grains receive a dose rate less than that corresponding with the mean composition. A ratio of feldspar/quartz dose rate of 2.4 at a grain size of 350 μ is indicated, and presumably results from this extreme situation. There are indications also that the U/Th as well as the K_2O is concentrated in the feldspar.

(b) Samples $<$ 350 μ after etching in HF. 6, 6a, 6c, 7a, 11, 13.

These samples were etched for 45 min. in 40% HF, washed in water and dried using acetone. The main feature of the results was the absence of a plateau, as shown in Fig. 3b. The ratio of archaeological to artificial TL shows a marked peak in the region of 300°C. The artificial TL signal is shown in Fig. 3a, and has peaks at 190 and 250°. It was realised that these TL signals were characteristic of CaF_2, and x-ray analysis confirmed that this compound was present. It had not been present in the samples before etching in HF. X-ray analysis showed broadening of the CaF_2 lines indicating poor crystallinity, consistent with formation in situ. It is presumably formed by reaction of the HF with the feldspar. This behaviour was further confirmed by measuring the TL on sample 8b, after HCl only, and then etching in HF. Subsequent measurement of TL gave the result 8c after an artificial β dose, similar to the results of series 6 samples. The CaF_2 gives no archaeological signal, but a large artificial signal especially in the 300° region.

(c) Larger grains.

By handpicking after sieving, it was possible to select clear translucent grains 0.3 - 1mm., and by optical examination to distinguish quartz from feldspar. There was then no need to use HF in order to isolate quartz inclusions. Results were as in Fig. 4. There was little variation of TL with temperature above 270°C, and there was a fairly good plateau from 250 to 380° (Fig. 4b). The archaeological dose was now equivalent to a mean of 87 min., in good agreement with the predose result on the larger grains (Wright 1979a).

It was now possible to check whether HF has the undersirable effect of producing CaF_2 by reaction with quartz. Grains separated as shown above were given the standard etching in HF, followed by washing in water and acetone leading to the results on sample 10. These were indistinguisable from the results on sample 9. showing that either CaF_2 is not produced in reaction with HF, or with large grains it is readily removed by normal washing.

(d) Removal of CaF_2.

Samples from which all calcite had been removed by HCl treatment were etched in HF and then treated in Al Cl_3, as recommended by Carriveau (1977). Although the solution did not clear completely, x-ray analysis showed no evidence of CaF_2, and the TL results were as in Fig. 4.

Another sample containing residual calcite was etched in HF and treated in Al Cl_3 and did give residual CaF_2, and results as in Fig. 3. Thus CaF_2 is more readily produced, or less readily removed, when HF reacts with Ca CO_3 compared with feldspar, and correspondingly more care is then necessary to ensure CaF_2 removal.

(3) Conclusions.

When using the conventional quartz inclusion method, great care is necessary (a) to ensure removal of feldspar, and (b) to avoid production of fluorite by reacting HF with feldspar or calcite. Large errors in age or absence of plateau can be produced by failing to meet these conditions.

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FIG. 1

Sample 4e

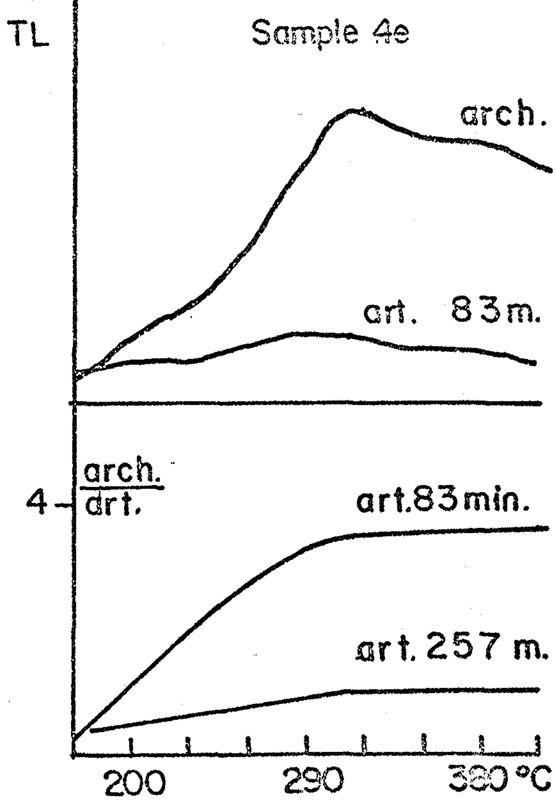
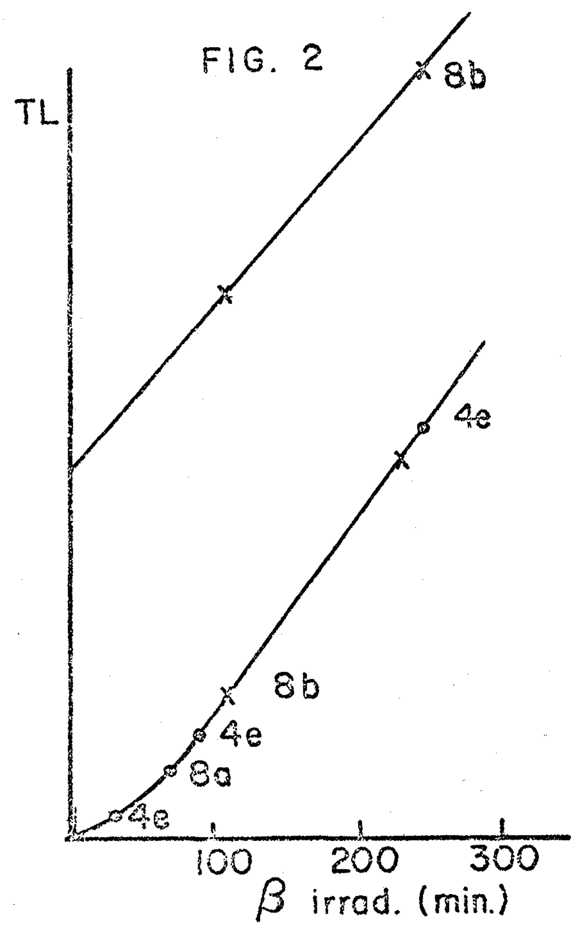
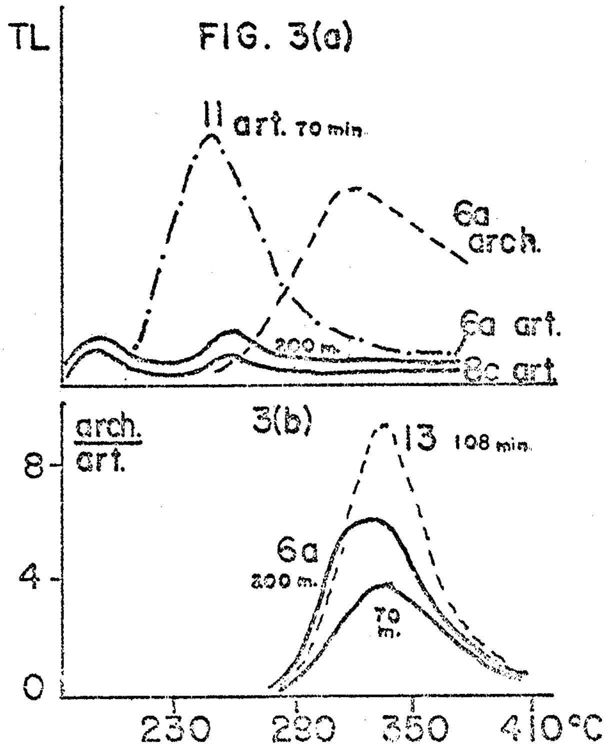
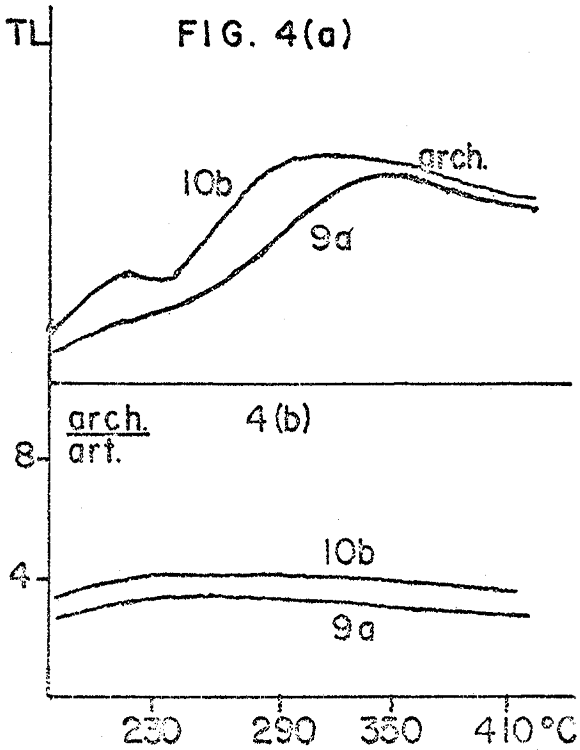


FIG. 2







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