

Explaining discrepant depth profiles of $^{234}\text{U}/^{238}\text{U}$ and $^{230}\text{Th}_{\text{ex}}$ in Mn-crusts

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Manganese encrustations are an important archive for the reconstruction of deep ocean circulation in the past. However, because of discordant growth rates derived from the decrease of the activity ratios of $^{234}\text{U}/^{238}\text{U}$ and of $^{230}\text{Th}_{\text{ex}}$ with depth their dating via the measurement of depth profiles of ^{230}Th and ^{231}Pa has been recently put into question (Chabaux *et al.*, 1997).

In this study we present high precision depth profiles of uranium and thorium isotopes (TIMS) covering 2 mm depth and consisting of 20 samples of a hydrogenetic Mn-crust TKD 40 from the South China Sea.

Indeed, the depth profiles of $^{234}\text{U}/^{238}\text{U}$ and $^{230}\text{Th}_{\text{ex}}$ deliver very different growth rates of 9.2 and 3.3 mm/Ma, respectively (Fig. 1). We solve this discrepancy with a simple model which assumes exchange of uranium with the pore water. The best fit to the data is when exchange of $0.5 \pm 0.1\%$ of the incorporated uranium per thousand years is assumed (Fig. 2a). Application of this model to the data set of Chabaux

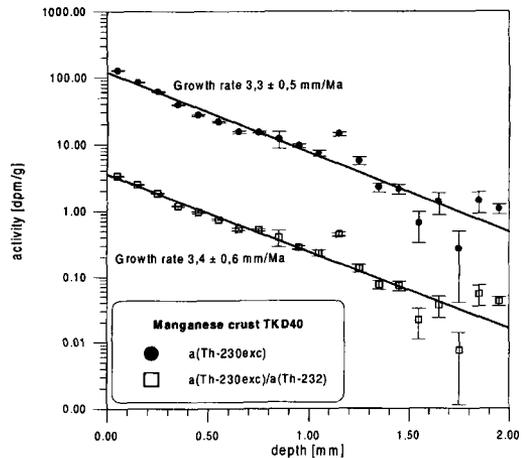


FIG. 1. Depth profiles of $^{230}\text{Th}_{\text{ex}}$ and of $^{230}\text{Th}_{\text{ex}}/^{232}\text{Th}$ in Mn-crust TKD 40.

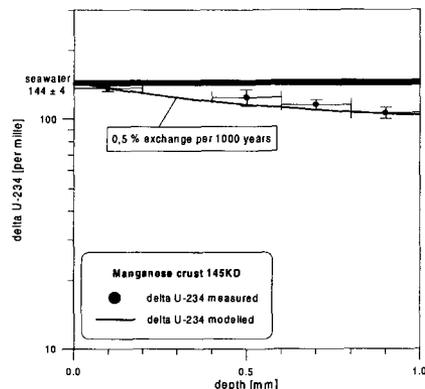
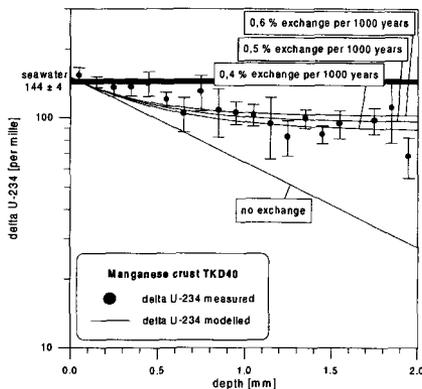


FIG. 2. Measured and modelled profiles of the activity ratio of $^{234}\text{U}/^{238}\text{U}$ in Mn-crusts: (a) TKD 40 and (b) 145 KD (Chabaux *et al.*, 1997).

et al. reproduces very well their profiles of the uranium activity ratio and confirms the model (Fig. 2b). We conclude that $^{234}\text{U}/^{238}\text{U}$ dating of Mn-encrustations is not reliable because of open-system conditions for uranium.

References

- Chabaux, F., Cohen, A.S., O'Nions, R.K. and Hein, J.R. (1997) *Geochim. Cosmochim. Acta*, **61**, 3619–32.