4.75 rhenium

The rhenium-osmium dating method is of special interest for the dating of rhenium-bearing ores, gold deposits, copper-nickel deposits, and meteorites. This method is based on the beta-decay of $^{187}\text{Re}$ (having a half-life of $4.16 \times 10^9$ years) to $^{187}\text{Os}$, an example of which appears in Figure 4.75.1 [512].

4.75.1 Rhenium isotopes in geochronology

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Fig. 4.75.1: Cross plot of $n(^{187}\text{Os})/n(^{188}\text{Os})$ isotope-amount ratio and $n(^{187}\text{Re})/n(^{188}\text{Os})$ mole ratio of marine and non-marine organic-rich sediments and coals from Egypt (modified from [512]). The Maghara area (~200 km east of Cairo) has middle-Jurassic coal beds (~165 × 10$^6$ years old, identified by the green dotted line). The age of marine black shales in the Red Sea area was previously estimated as 74 × 10$^6$ years old, identified by the blue dotted line. $^{187}\text{Os}$ is produced by decay of $^{187}\text{Re}$. Samples from an older formation will have proportionally more $^{187}\text{Os}$ because of the longer accumulation time for $^{187}\text{Os}$; thus, the slope of the line for the Maghara coals (turquoise triangles), having an age of 165 × 10$^6$ years, is substantially higher than the slope of the Red Sea specimens. Note the analytical challenges in obtaining isotope-amount values that plot near the 165- and 74-million-year isochrons. Many of the values plot between the isochrons.
4.75.2 Rhenium isotopes in medicine

\(^{186}\)Re (with a half-life of 89 hours) is a beta-emitting radioisotope that is used for cancer treatment, in particular for pain relief in bone cancer and in rheumatoid arthritis (see radiosynovectomy). It is produced from the stable isotope \(^{185}\)Re via the \(^{185}\)Re (n, \(\gamma\)) \(^{186}\)Re reaction [185]. \(^{186}\)Re is also used for radiolabeling of cancer therapeutic agents [185]. \(^{188}\)Re is used to irradiate coronary arteries with beta particles during insertion of an angioplasty balloon (a tiny balloon that is inserted into an artery and inflated to flatten plaque build-up and improve blood flow) and in palliative therapy, particularly for bone metastases. The beta irradiation can decrease scar tissue formation after the overstretching of arteries by angioplasty.