4.86 radon

Both $^{220}$Rn and $^{222}$Rn (with half-lives of 56 seconds and 3.8 days, respectively) are used to study underground environmental as well as atmospheric gaseous-transport processes [565-567]. The interaction of radon with streams and rivers enables it to be used commonly as a tracer in groundwater studies (Figure 4.86.1). $^{222}$Rn has a short residence time in streams and river
channels, which leads to radon loss. As a result, if an area of a stream or river has a high concentration of radon, it suggests that there are local groundwater inputs [565-567]. In a deep (100 m) contaminated aquifer at a refinery site in Mexico, where the contaminated source was too deep to be directly accessible for sampling, Schubert et al. [568] collected groundwater samples from a few wells available at the site. They used the partitioning of the natural tracer $^{222}$Rn between uncontaminated groundwater and the NAPL (non-aqueous phase-liquid like oil, gasoline, and petroleum) source zone, and they were able to approximately identify the location of the NAPL source zone. As noted in Section 4.88.1, $^{222}$Rn has been used to quantify submarine groundwater discharge [569].

![Fig. 4.86.1: Air-water equilibrator, which strips radon out of water and into the gas phase so it can be used as a groundwater tracer. (Photo Source: John Crusius, U.S. Geological Survey) [570].](image)

### 4.86.2 Radon isotopes in geochronology

$^{222}$Rn has been used as a tool to date groundwater when used in combination with other isotopes or elemental ratios (i.e., helium/radon and xenon/radon mole ratios have been used to date groundwater) [565, 571].