REFERENCE 11

3.1 Natural occurrence

In some geographical areas, forest fires and volcanoes are the main natural sources of PAH in the environment (Beek et al., 1991). In Canada, about 2000 tonnes of airborne PAH per year are attributed to natural forest fires (Environment Canada, 1994). On the basis of samples from volcanoes, Yinitsky et al. (1977) estimated that the worldwide release of benzo *[a]*pyrene from this source was 1.2–14 t/year; no estimate was given of total PAH emissions from this source.

Coal is generally considered to be an aromatic material. Most of the PAH in coal are tightly bound in the structure and cannot be leached out, and the total PAH concentrations tend to be higher in hard coal than in soft coals, like lignite and brown coal. Hydroaromatic structures represent 15–25% of the carbon in coal. The PAH identified include benz *[a]*anthracene, benzo *[a]*pyrene, benzo *[e]*pyrene, perylene, and phenanthrene (Neff, 1979; Anderson et al., 1986). Table 8 shows the typical contents of PAH in different crude oils, such as those derived from coal conversion or from shale.

Table 8. Polycyclic aromatic hydrocarbon content of crude oils from various sources

Compound	PAH content (mg/kg) in crude oil from		
	Coal[a]	Petroleum	Shale
Acenaphthene	1700/1000	147–348	147–903
Anthracene	4100	204–321	231–986
Anthanthrene	Trace/< 000	NR	0.3
Benz[a]anthracene	Trace/< 2200	1–7	1
Benzo[a]fluorene	2100/2500	11–22	53
Benzo[a]pyrene	< 500/< 1200	0.1–4	3–192
Benzo[b]fluorene	< 1500/3400	≤ 13	140
Benzo[c]phenanthrene	< 600/< 2200	NR	NR
Benzo[e]pyrene	< 1200/1300	0.5–29	1–19
Benzofluorenes[b]	< 500/< 1300	23	NR
Benzo[ghi]fluoranthene	3200	NR	NR
Benzo[ghi]perylene	4300/6600	ND–8 ND–5	1–5
Chrysene	< 1500/2500	7–26	3–52
Coronene	NR	0.2	NR
Dibenz[a,h]anthracene	NR	0.4–0.7	1–5
Fluoranthene	< 1900/< 3700	2–326	6–400
Fluorene	5300/9900	106–220	104–381
1–Methylphenanthrene	< 1200/< 5100	> 21	NR
Naphthalene	100/2800	402–900	203–1390
Perylene	Trace/< 600	6–31	0.3–88
Phenanthrene	12 000/20 400	> 129–322	221–842
Pyrene	14 200/35 000	2–216	10–421
Triphenylene	NR	3/13	0.8

From Guerin et al. (1978), Weaver & Gibson (1979), Grimmer et al. (1983a), Sporstol et al. (1983), IARC (1985, 1999b)
Ranges represent at least three values; NR, not reported; ND, not detected
[a] Two crude oils from coal conversion; single measurements
[b] Isomers not specified

Two rare PAH minerals have been described: the greenish-yellow, fluorescent curtisite from surface vents of hot springs at Skaggs Springs, California, USA, and the bituminous mercury ore idrialite from Idria, Yugoslavia, the two main components of which are chrysene and dibenz *[a,h]*-anthracene. These minerals are assumed to have been formed by the pyrolysis of organic material at depths below that at which petroleum id generated (West et al., 1986).