1. Introduction

The Czech Republic (CR) is more or less self-sufficient in supplies of bituminous coal and lignite from its own deposits. More than 12 mill. tons of hard coal and about 49 mill. tons of lignite are extracted annually. The first written records of mining for coal in the territory of the present CR date from the year 1463. The exploitation of this raw material had become intensive by the second half of the 19th century so that the coal reserves in many deposits and/or the majority of coal basins were soon exhausted. Carboniferous bituminous coal is still mined only underground in the Czech part of the Upper Silesian Basin. Tertiary lignite is extracted mostly from large open-cast mines (99 %) in the North Bohemian (NBB) and Sokolov basins (SB) and from one underground mine in the South Moravian coal district of the Vienna Basin (Fig. 1). In the 1950s much the possible extraction of germanium and gallium was studied as strategic raw materials. Bouška and Pešek (1999a, b) summarized results of the analyses of elements in ash from all lignite basins published or stored in archives.

2. Short history of investigation of trace elements in coal

During combustion of coal, numerous trace elements are emitted into the atmosphere and may endanger the environment and human health. The first discussion of the distribution of trace elements in European coals was firstly given by Goldschmidt (1935), using for that time modern analytical methods – emission spectrographic and X-ray fluorescence analyses. His estimations of trace elements average contents were for many years unique data. At a later time some averages (Clarke values) were published, i.e. by Krauskopf (1955), Bethell (1962), Krejci-Graf (1972), Valkovič (1983), Yudovich et al. (1985), and Swaine (1990). In 1990s, due to serious environmental problems caused by wider consumption of coal in electric power plants, amount of trace element analyses extremely increased (Bragg et al. 1998). Quite a new data of coal Clarke values collected from more than hundred thousands analyses were published by Ketris and Yudovich (2008, 2009).

3. Methods of investigation

This paper provides a critical assessment of a database of chemical and technical analyses and contents of elements in ashes from all the bituminous coal basins of the CR (Fig. 2). The database was created through the acquisition of more than fifty thousand analyses published or stored in archives, including calculations of coal reserves held by the Czech Geological Survey – Geofond (the state organization responsible for storing unpublished reports and manuscripts). These data were supplemented by the study

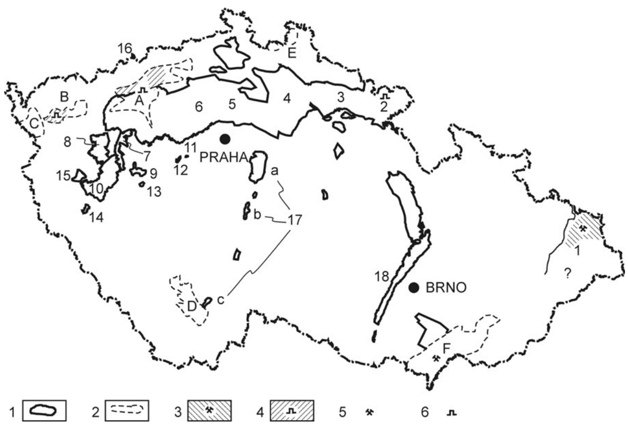

Fig. 1. Distribution of Upper Paleozoic and Tertiary coal-bearing basins in the Czech Republic. 1 – outline of Upper Paleozoic basins, 2 – outline of Tertiary basins, 3 – region with present underground mining activity, 4 – region with present open cast mining activity, 5 – recent local underground mining activity, 6 – local open cast mining activity; 1–10 Upper Paleozoic hard coal basins: 1 – Czech part of the Upper Silesian, 2 – Czech part of the Intra-Sudetic, 3 – Krkonoše Piedmont, 4 – Mnichovo Hradiště, 5–10 Central and West Bohemian: 5 – Mšeno-Roudnice, 6 – Kladno-Rakovník, 7 – Žihle, 8 – Manětín, 9 – Radnice, 10 – Plzeň, 11–15 Carboniferous relics (occurrences): 11 – Malé Přílepy, 12 – Lísek, 13 – Mirošov, 14 – Merklín, 15 – Vranov, 16 – Brandov, 17–18 grabens: 17 – Blanice, relics: a – Český Brod, b – Vlašim, c – České Budějovice, 18 – Boskovice; A–E most important Tertiary lignite basins: A – North Bohemian, B – Sokolov, C – Cheb, D – České Budějovice, E – Czech part of the Žitava, F – South Moravian coal district (part of the Vienna Basin).

of maceral composition of the coals and the chemical and technological parameters of 21 new samples that were collected from galleries and also from dumps at abandoned mines, taking into account that such samples could be as much as a few decades old. Contents of elements in such samples may be subject to leaching so that the analyses obtained may differ from those of "freshly" collected samples (cf. Swaine and Goodarzi, Eds 1995). New analyses come mostly from chip samples with ash content (A^d) < 55 % while contents of few samples undertaken from some unpublished reports reached up to 99.99 %. All newly collected samples were ashed by temperature 850 °C whereas temperature of ashing of older samples is not known. Nine of recently collected samples were analyzed at the US Geological Survey at Reston (USA) and another 16 samples were studied in the laboratories of the Czech Geological Survey. The concentrations of PGE in 13 samples were determined in the laboratories of the Faculty of Science at Charles University. The contents of trace elements in coal ashes were determined at Reston using Inductively Coupled Plasma-Atomic Emission Spectroscopy (ICP-AES) and Inductively Coupled Plasma-Mass Spectrometry (ICP-MS). Coal ashes were also analyzed at the laboratories of the Czech Geological Survey by Flamed Atomic Absorption Spectrometry (FAAS) and/or Mercury Atomic Absorption Spectrometry (HGAAS; As and Bi) and by Atomic Absorption Method (AMA; Hg). The concentrations of Cl, Hg, S and Se were in coal established. Contents