Mineral and chemical composition of the biomass ash

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Biomass is considered as important non-fossil renewable energy source. Its share in co-combustion with hard coal in power plants in Poland increases. Addition of biomass significantly modifies the composition and properties of fly ash and influences possiblilities of its application. The study is based on mineralogical and chemical analysis of ash obtained at temperature ca 470^{o}C from various types of biomass.

Content of elements in ashes varies within broad range, e.g. Ca from below 2 (corn bran) to >16 wt% (sawdust); P from below 0.5 (beech bark) to >5 wt% (corn bran and palm kernels); Mg from 0.6 (beech bark) to 6.3 wt% (corn bran); K from 2.3 (beech bark) to >10 wt% (corn bran, sunflower, sawdust, olive residue, straw, palm kernels); S from 0.5 (beech bark, corn bran) to >3 wt% (sunflower).

Mineral composition of ash is variable. Beech bark ash is composed of quartz, calcite, fairchildite, lime, mica and barite and aluminosilicate spheres as minor components; olive residue ash contains quartz, arcanite, talc, kutnahorite and Fe oxides, and Zn sulphide as minor components; sunflower ash – fairchildite, arcanite, quartz ; straw ash – quartz, calcite, bustamite; palm kernel ash – quartz, calcite, bayerite, cristobalite, and Mg, K, Ca phosphates; sawdust ash – calcite, fairchildite, quartz, gatehauseite (?), and barite, zincite, lime, K and Mg phosphates as minor componets; corn bran ash – tephroite, quartz, corundum, and K and Mg phosphate aggregates composed of very small spheres (ca 1 μm in size).

Very small grains are abundant in the studied ash samples. For example, sunflower ash is composed of very fine carbonate and sulphate particles, straw ash is rich in small rods and prisms of quartz and carbonates.

Mineral and chemical composition of ash is related partly to the composition of plants but content and composition of detrital components (derived from soil, atmospheric dust particles deposited during cultivation or storage) is also important. Relatively big angular or rounded quartz grains of detrital origin are present in several samples (abundant in sawdust and beech bark ash). K-feldspar grains (up to 0.2 mm in size) are present in beech bark ash. Aggregates composed of kaolinite in iron oxides matrix (probably derived from soil) are present in palm kernels ash. Small detrital grains are probably also present but their identification is dubious.

Significant variation in mineral and chemical composition of biomass ash suggests that usage of various types of biomass in co-combustion with coal can result in strong variation of fly ash composition.

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Pre-Late Heavy Bombardment terrestrial crust: review of the zircon evidence for its nature and origin

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Distribution

Evidence of pre-Late Heavy Bombardment (LHB) [1] crust on Earth is hampered by the myriad of subsequent geologic processes that could potentially destroy it. However, zircons pre-dating the LHB at 3.85-3.95 Ga are widely distributed on Earth. Locations include the Slave Craton of Canada [2], the Yilgarn Craton of Western Australia [3], Enderby Land in Antarctica [4], and the North [5] and South [6] China cratons, as well as in Tibet [7].

This distribution in four continents and in a variety of hosts that include igneous, metamorphic and sedimentary rocks – and with an age range for the hosts from 4.03 Ga to 0.05 Ga – establishes both the wide distribution and the long-term survival of the ancient grains, and potentially portions of ancient crust.

Origin

The question remains as to the origin and source of these ancient zircon crystals. Models for the site of generation include a solidified magma ocean, oceanic islands or extensive continental crust with oceans; driven by either modern-style plate tectonics or processes possibly unique to the early Earth. Intriguingly, zircon hafnium model ages indicate a dichotomy in the 3.95-4.4 Ga population: some extend back to 4.4-4.5 Ga, whereas others are younger and within error of the U-Pb crystallization age. Similarly, in the oldest rocks that just post-date the LHB, zircon hafnium model ages rarely extend back much beyond 4.0 Ga: what is the significance of this? In terms of preservation, evidence from the Yilgarn Craton indicates that ancient zircon was present in the mid/lower crust in the late Archean, becoming incorporated in granitoid magma at that time. However, in the North and South China cratons, the depository was tapped in the Phanerozoic. In the North China Craton, this occurred in the Ordovician, whereas in the South China Craton, ancient zircon was incorporated in Cenozoic volcanic rocks. So what are the controls on this distribution and how do they relate to continental formation, destruction and amalgamation? A variety of scenarios will be examined in an attempt to explain these features.

[1] Tera et al (1974) *EPSL* **22**, 1-21.
[2] Bowring and Williams (1999) *CMP* **134**, 3-16.
[3] Wilde and Spaggiari (2007) Elsevier *Developments in Precambrian Geology* **15**, 275-304.
[4] Black et al (1986) *CMP* **94**, 427-437.
[5] Diwu et al 2010 *Acta Petrol Sinica* **25**, 1171-1174.
[6] Zheng et al (2011) *GCA* **75**, 242-255.
[7] Duo et al (2007) *Chin Sci Bull* **52**, 23-26.