

Analysis of historic glass by ion-beam methods

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Between 800 BC and 800 AD, the majority of glass in the ancient world was made with the alkalis derived from natron, the dry sediment of Egyptian lakes. Natron-made glass can easily be distinguished from its counterpart made of the ash of halophytic plants, as natron is chemically purer than ash. Multi-element composition of historic glass is readily checked by ion beam analytical methods PIXE and PIGE, which provide good sensitivity both for light and heavy elements and are nondestructive. For the measurements performed in air, attenuation of X-rays limits analysis to the elements of silicon and heavier. Important glass elements Na, Mg and Al are then determined according to the intensity of gamma rays, induced by inelastic proton scattering. Historic glass, studied at Jožef Stefan Institute, involves Greek-made glass from Apollonia Pontica, Roman glass of the Imperial period from Albania, Bulgaria and Serbia, and Late Antique glass from Bulgaria and Slovenia. It can be noticed that earlier glass contains less impurity elements, and reveals multiple origins of raw materials – until during the Late Antiquity the production concentrated in the present Egypt and Palestine. Around 800 AD, natron type glass was gradually replaced by the glass made of the ash of halophytic plants, which finally evolved in the Venetian and Venetian-type glass around 1200 AD. The composition of glass beads can be used for dating the medieval graves. An important change before the industrial era occurred in the 16th c., when purer agents and different decolorizers entered into use. Till the end of the 19th century, potassium-based forest glass continued to be manufactured in small glasswork plants in the central Europe.