Evaluating oil-shale byproducts of environmental concern by hydrous pyrolysis

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The goals of this study were to (1) compare byproducts of environmental concern in generated gases, recovered waters, and residual spent rocks; and (2) evaluate organic matter type and the mineralogical controls on their occurrence. Hydrous pyrolysis is a method for simulating petroleum generation that involves heating source rocks in the presence of sub-critical liquid H_2O (<374 ºC) for hours to days. In this study, 200-g aliquots of twelve oil shale samples were heated at 360 ºC for 72 h in the presence of water**.** The oil shales included kukersite (Estonia), Green River Fm. mahogany shale (Colorado, USA), Irati Fm. (Brazil), Permian torbanite (NSW, Australia), Pumpherston Shale (Scotland), Kimmeridgian Blackstone (England), Ghareb Limestone (Israel and Jordan), Retort Phosphatic Shale Member of the Phosphoria Fm. (Montana, USA), New Albany Shale (Indiana, USA), Timahdit oil shale (Morocco), and Alum Shale (Sweden). Analyses were conducted on (1) recovered waters for dissolved polynuclear aromatic hydrocarbons, major and trace metals, ammonia, and total sulfide; (2) generated gases for carbon dioxide, carbon monoxide, hydrocarbons and hydrogen sulfide; (3) original and spent shale for mineralogy, chemical composition, and organic matter amount, type, and maturity. Hydrous-pyrolysis under these conditions does not necessarily determine ultimate yields of byproducts of environmental concern for all retorting conditions. However, it does provide a baseline to compare concentrations and yields of these components, and can be used to evaluate potential environmental risks as interest in oil shale exploitation increases, and new methods for oil shale production are evaluated.