Study on bioleaching of uranium ore in magnetic stirring reactor and gas stirring reactor

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The leaching ore is selected from a uranium deposit which is located in South-East China. U^{4+} has a large proportion, accounting 84% of the total uranium. This uranium ore is hard for leaching. In the conventional leaching process, the strong oxidizer must be added. The ore, however, contains pyrite and other minerals. Ferrous is about 1.25% for chemical compositions and sulfur is 0.45%. They can be used as energy source for bacterial growth [1]. Thus bacterial leaching is very favorable for leaching this ore. In this research, the acidophilus bacteria, which are screened from this uranium mine and acid mine water, identified as thiobacillus ferrooxidans, thiobacillus thiooxidans and leptospirillum ferrooxidans. These bacteria are domesticated by UV mutagenesis and low pH, as well as some toxic ions such as high F and the high toxic metal ions in culture. They can tolerate high fluoride and high toxic metal ions and can grow fast in low pH value ranging from 1.0 to 2.0.

Two bioreactors, the magnetic stirring reactor and the gas stirring reactor, are used in this experiment. The main factors and the leaching effect have been studied. The leaching result shows that, the bacteria leaching decreased sulphuric acid consumption by 23.1%, compared with sulphuric acid leaching both for these two leaching reactors. The appropriate time achieving high uranium concentration ranges from 4 to 6 hours. For the magnetic stirring reactor the rate of uramium leaching can reached 91.1%, while, the leaching rate for the gas stirring reactor is some lower and reached 85.6%.

This study is financially supported by the Ministry of Science and Technology of the People's Republic of China under International Cooperation Project: Research on Bioleaching Technology of Low-Grade Metal Resources (2008).

[1] Li Guang-yue *et al*. (2009) *Chinese Journal of Nuclear Science & Engineering* **1**, 92–96.

Evaluation of Permian marine source rocks using paleoproductivity and paleoredox proxy coefficients

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Identification and evaluation of marine source rocks is of crucial importance for hydrocarbon exploration in marine basins. Productivity and redox conditions are main factors controlling the formation of effective source rocks. Some trace elements can be regarded as proxies for the restoration of paleoproductivity and paleoredox conditions. In this study, 167 samples from Permian marine deposits with a thickness of 380m in the Shangsi section, South China, are measured for trace elements and total organic carbon (TOC). Two groups of elements are chosen for proxies indicating the paleoproductivity of organic matters and the paleoredox conditions for deposition. Using measured Mo_{xs}, U_{xs}, V_{xs}, Cu_{xs}, Ni_{xs} and Zn_{xs} (X_{xs} is a relative excess of element X compared to titanium in post-Archean Australian Shale) in rock samples, we have obtained two integrated coefficients by principal component analysis: the paleoproductivity (Y_1) and the paleoredox (Y_2) coefficients,

$$Y_1 = 0.588 \times V_{xs} + 0.575 \times Mo_{xs} + 0.569 \times U_{xs};$$
$$Y_2 = 0.611 \times Zn_{xs} + 0.594 \times Cu_{xs} + 0.523 \times Ni_{xs}.$$

Theoretically, a higher value of Y_1 would correspond to a higher level of paleoproductivity; a higher value of Y_2 would indicate a more reducing condition. For samples with higher levels of TOC, both Y_1 and Y_2 show good correlations with it. After fitting linear equations and cluster analysis of Y_1 and Y_2 in samples with different lithologies, colors and laminating thicknesses in limestone, respectively, an evaluation system for effective source rocks has been established. Evaluation results show that dark shales interbedded with silicalites, and thin-laminated limestone are favourable for the formation of high-quality marine source rocks. Thus, these multi-proxy coefficients for the restoration of paleoproductivity and paleoredox conditions could be used to develop an evaluation system in marine source rocks.