Preliminary Application of an Oil Shale Basin Retorting Simulation

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The Piceance Basin in Western Colorado contains one the world's richest oil shale deposits. With the ever-growing need for energy and petroleum products the oil shales of the western United States have become increasingly attractive for development. The Piceance Basin is a spatially complex system with oil shale richness varying horizontally and vertically as do the precious surface and groundwater resources. The general public and various levels of government are asking what does a full scale commercial operation with multiple companies look like, how might extraction progress and what are the demands on the water resources and land? The objective of this model is to simulate this process with a broad range of scenarios given a large range of spatial and temporal uncertainty to understand and visualize the commercial development of the basin. Given the scope of the problem a basin wide extraction scenario using a Multi-Agent simulation, Global Information Systems (GIS), and reinforcement-learning algorithm will be used to drive the model. Characterization of this environment is accomplished in a GIS framework and spatial geodatabase. The Multi-Agent simulation controls the state of the system and actions or in this case movement and extraction of the oil shale across the basin and use of the available water resources. The heuristic machine learning algorithm, reinforcement learning, is used for generating, evaluating, and improving the multi-objective decisions and actions of the agents. Given then a set of objectives based on the agents' extraction method and resource allocation a quasi-optimum scenario of oil production can be found. This study focuses on setting up the initial framework for this process. The objectives, policies, and rewards may be spatially dependent and unique to each agent. However, they may be governed by global objectives represented by regulations imposed by state and federal government as well as overriding environmental, water resource and economic factors. It is important to understand this is a general process simulation tool used to quickly evaluate different possible scenarios in highly uncertain complex systems. It is intended to inform, not direct either policy decisions or financial considerations in the acquisition of the resource for development.