OBJECTIVES

The technical objectives of this research program are to develop an analytic approximation for a frequency dependent seismic source model for underground nuclear explosions in dry, porous media analogous to the Mueller/Murphy model for explosions in hardrock and water-saturated media, and to then apply this model to a quantitative assessment of seismic monitoring capability relative to explosions in such media. This is being accomplished by conducting source scaling analyses of broadband seismic data recorded from explosions in such media at NTS to define their frequency dependent source coupling characteristics relative to the already well-documented seismic source coupling of corresponding explosions in "good-coupling" media at that same test site. The ultimate objective is to improve U.S. operational nuclear test monitoring capability by providing a reliable seismic source model that can be used to quantitatively address seismic detection, identification and yield estimation capability as functions of yield, depth of burial and the physical characteristics of the source medium for small underground nuclear tests which might be conducted in such low-coupling media.

RESEARCH ACCOMPLISHED

This project is just beginning, so the following discussion focuses primarily on background and plans as opposed to accomplishments to date. It has long been recognized that normal depth explosions in almost all hardrock and water-saturated emplacement media (i.e., "good-coupling" media) are roughly consistent with a single mb/yield relation for any fixed tectonic source region. In fact, the only media which are known to give consistently different results for fully tamped explosions are saturated clay or water and dry, porous media, such as the dry tuff and alluvium found above the water table at NTS. These observations are summarized in Figure 1, where it can be seen that the average mb value for explosions of fixed low yield in saturated clay or water is expected to be higher by about 0.50 ± 0.25 magnitude units, while the value for explosions in dry, porous media is expected to be lower by about 0.50 ± 0.25 magnitude units relative to that for explosions of the same yield in good-coupling media. It follows that, with the exception of cavity decoupled explosions, which are not always technically feasible, small explosions in dry, porous media pose the greatest challenge to effective seismic monitoring.

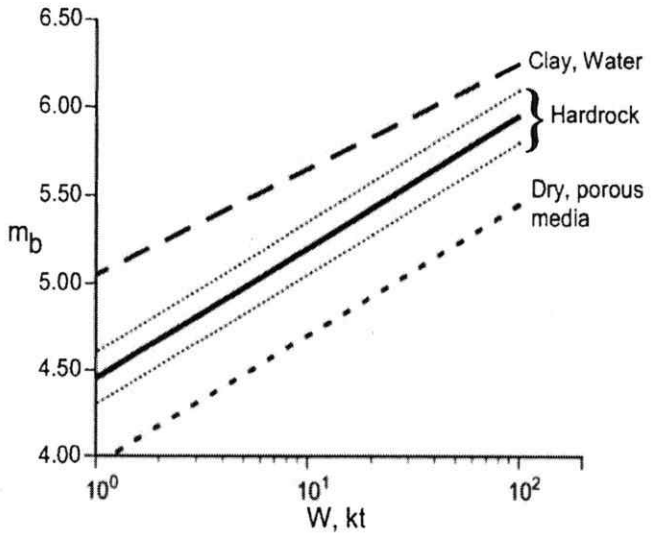

Figure 1. Comparison of mb/yield relations for fully tamped underground nuclear explosions in a fixed tectonic source environment, illustrating the effects of source medium on seismic coupling. It can be seen that the average mb value for explosions of fixed low yield in dry, porous media is expected to be lower by about 0.50 ± 0.25 magnitude units relative to that for explosions of the same yield in hardrock media.