Evaluation of Microbubble Seep Theory

Monte Meers
Meers, Microseep Technology

Surface geochemistry and the study of seeps and microseeps has been part of oil and gas exploration since Drake drilled his discovery well on an island in Oil Creek near Titusville, PA in 1858. A wide variety of methods for detecting seeps have since been developed, but irrespective of the geochemical exploration methods, an understanding of seep paths and signatures is critical to applying these methods to drill site selection. For a better understanding of these ideas, we have developed a numerical solution to the anisotropic diffusion equation where we introduce the concept of effective diffusability to examine the preferential movement of gas in the vertical direction. In addition, we also developed a physical sandbox model to evaluate numerical results, and as an alternative method of investigation.

Our studies suggest that the halo anomalies reported in the literature are the result of loss of vertical permeability over oil and gas reservoirs (plugs), an idea supported by a study of acoustic velocity distribution. Also, structural dip of beds of varying degrees of anisotropy shift seeps down dip; faults and fracture systems may also shift seeps away from the center of the reservoir.

If the reservoir is narrow or not associated with structure the seep is directly over the reservoir – an apical signature. These signatures can be shifted by regional dip or variations in overlying geology. Our modeling also suggests that the thickness of the weathered zone may affect the magnitude and sharpness of the seep signatures. These effects detract from data that are already inherently noisy. We suggest that ample sampling and noise reduction is needed to adequately de-scribe seep patterns.

We conclude that our numerical model, although restricted because of our inability to quantify the effective diffusability, is a useful tool for understanding the paths of microseeps. Physical models are useful for appreciating some of the effects of the environment, and for evaluating numerical results.