INTRODUCTION

Enterprise Products Operating L.P. operates brine production and hydrocarbon storage caverns at three terminals in the Barbers Hill salt dome at Mont Belvieu, Texas. The vast majority of solution-mined caverns at Mont Belvieu are LPG storage caverns. However, about 5 percent of the caverns are used for brine production for the chemical industry as well as for LPG product movements from the storage caverns.

As with virtually all Gulf Coast domes, Boundary Shear Zones (BSZ) [Kupfer, 1973] exist in the Barbers Hill salt dome. Kupfer [1973] provides a graphical illustration (Figure 1) of BSZ development in a salt dome. As characterized by Kupfer, the BSZ is essentially a salt spine boundary which may or may not include a nonsalt constituent, and is often composed of numerous "planes of preferred dissolution," which very likely will include some porosity which will be either gas and/or brine filled. Of course, Kupfer's illustration is a simplification of a structural geology characteristic in salt domes that can vary widely from dome to dome and from BSZ to BSZ. For example, BSZs may consist of more than a single plane of preferred dissolution. Additionally, differences in salt characteristics across BSZs are not always found. However, the common feature of many, if not all BSZs, is the existence of porosity on one or more planes of preferred dissolution–porosity that is not connected to the outside of the salt dome.

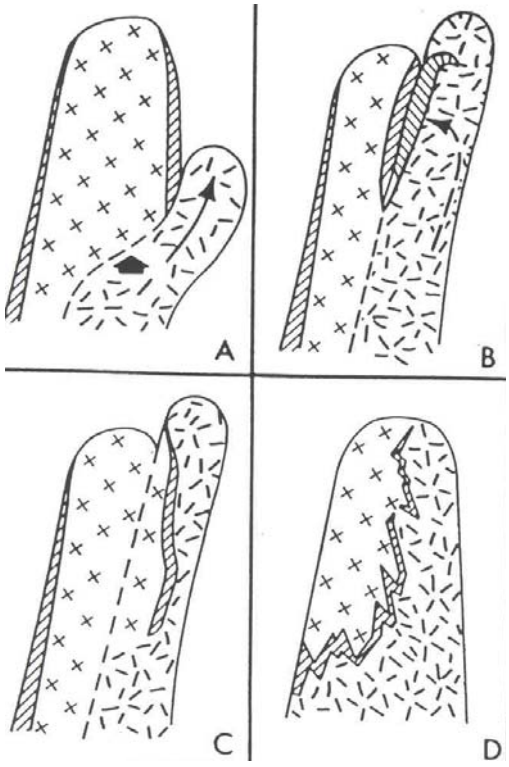

Figure 1. Boundary Shear Zone Development in a Gulf Coast Salt Dome (After Kupfer [1973]).

When a solution-mined cavern is developed in a salt dome in the Gulf Coast, the cavern is very often a near-perfect cylinder. When the solution-mining well intersects a plane of preferred dissolution, the resulting cavern is not cylindrical. The planes of preferred dissolution that show up in the solution-mined storage caverns generally dip consistently with the dip of the nearest boundary of the salt dome. Figure 2 illustrates a solution-mined cavern developed in the Barbers Hill salt dome that has intersected a plane of preferred dissolution. The "up-dip" intersection of the plane with the cavern is solution mined to a greater extent than the "down-dip" intersection of the plane with the cavern. This occurs because the injected fresh water tends to rise after exiting the injection casing and will leach "upward" more rapidly than "downward."

About 25 percent of the solution-mined caverns in the Barbers Hill salt dome have intersected planes of preferred dissolution. The vast majority of these intersections have occurred deep in the cavern interval. Occasionally, a cavern has intersected more than one plane and the resulting "salt block" has spalled from the cavern wall. Until Enterprise Well 16E was drilled and developed, a Barbers Hill cavern had never intersected a plane of preferred dissolution essentially at the casing shoe. Well 16E was drilled in a location expected to be free of any BSZ or plane of preferred dissolution. However, a "yet-to-be-discovered" plane was encountered.

This paper describes (1) the Barbers Hill Dome and the Enterprise Mont Belvieu brine production facilities, (2) the solution-mining history and well testing that was used to diagnose and confirm the plane of preferred dissolution encountered in Well 16E, and (3) the field exploratory program that was used to reassess the location of new brine production wells.