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RESEARCH PROJECT REPORT
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SUBSURFACE INVESTIGATION AT WELL #56 CAREY SALT BRINEFIELD HUTCHINSON, KANSAS

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subsidence areas at the Carey brinefield and also at the Cargill site existed before the surface expressions of the subsidence, or whether the softening and fracturing occurred subsequent to the subsidence, cannot be determined conclusively. There is no doubt the shale encountered beneath Well #56 in the present investigation is of much better quality than that beneath the previously investigated subsidence areas. Considering the one-year period between the Well #50-#57 subsidence and the subsurface investigation at Wells #50 and #57, it is not likely that such extensive softening and fracturing of the shales occurred simultaneously with, or subsequent to, the subsidence events, but more likely had begun prior to the surface expression of the subsidence. Therefore, it seems most likely that the better-quality shale found beneath Well #56 is the result of the more limited exposure of the shale to the deteriorating action of fresh water beneath Well #56, and to the limited cavity spans beneath Well #56 which have restricted the development of cracks in the shale roof which would accelerate deterioration.

SUMMARY AND CONCLUSIONS

1. Five borings, ranging in depth from 436.5 ft to 552.5 ft (extending from 35 ft to 148 ft below the shale-salt contact), were drilled and cored at locations ranging from 20 ft to 77 ft from Well #56.

2. All of the borings encountered intact and undisturbed shale which extended to within a few feet of the shale-salt contact. No evidence of bed separations, sagging, or stoping of the roof shales was found in the borings except possibly within a few feet of the shale-salt contact at Boring V-8 (located 20 ft from Well #56).

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3. Only one boring, drilled 20 ft from Well #56, encountered an open cavity in the rock salt at the shale-salt contact. One boring, drilled 76 ft from Well #56,encountered an open cavity in the rock salt which extended from 1.5 ft below the shale-salt contact to about 3.5 ft below the contact. The remaining three borings encountered rock salt which showed signs of solution activity within about 10 ft of the shale-salt contact but no open cavities were found near the contact at these locations.

4. An extensive system of open cavities was found between the shale-salt contact and about 110 ft below the contact in the boring drilled 20 ft from Well #56. In the remaining borings, numerous zones of salt showing signs of solution activity were encountered throughout the depth cored,but the only significant open cavities (more than 1 to 2 ft in thickness) were found more than 100 ft below the shale-salt contact.

5. Interpretation of the drilling and coring results suggests the Well #56 cavity is elongated in the southeast-northwest direction with an unsupported shale roof spanning on the order of 150 ft in this direction. In the southwest-northeast direction, the unsupported shale roof span appears to be on the order of 50 ft. The zones of rock salt where solution activity was apparent extend to greater horizontal distances from Well #56 than these clear spans.

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6. The limited cavity spans inferred from the boring results and the good to excellent quality shale cored above the cavities are interpreted to be the result of the operational history of Well #56. Reportedly, Well #56 was never operated by injection of fresh water through the casing-tubing annulus, but rather fresh water or undersaturated brine was always injected through the tubing which extended to near the bottom of the salt beds.

7. Two beneficial effects are believed to have resulted from the well operation by bottom injection: (1) most solutioning occurred at depth in the salt beds so that large open spans did not develop at the shale-salt contact and, therefore, the resulting cavity beneath Well #56 did not develop a "morning glory" shape; and, (2) the limited amount of shale exposed in the roof and in the well bore itself was not subjected to the deteriorating action of fresh water, but rather was in contact, for the most part, with saturated brine.

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