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Dixie Valley Research Introductory Comments and Overview

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Over the past **two** years a diversified research effort at the Dixie Valley geothermal field has gradually taken form and is now beginning to produce some preliminary **results.** This effort has included everyone **from** graduate students to well known professionals working more or less independently on a wide variety of topics. The papers to be presented in this session to a large degree represent work which has only recently commenced and the results are therefore still very preliminary. Not all research activities are presented in this session. The various institutions currently involved in Dixie Valley geothermal research include the University of Nevada, **Stanford** University, Southern Methodist University, the U. S. Geological Survey, Lawrence Berkeley Laboratory, EGI, Los Alamos National Laboratory, and William Lettis and **Associates.** Some of these entities **are** involved in more than one research topic. Perhaps **40** individuals will have their names on papers presenting the **results** of **this** research. Over the next couple of years it **will** be very interesting **to** follow the completion of the individual projects and the ultimate melding of these works into an integrated study of a Basin and Range geothermal system. Much of the direct costs of this research have been borne by the Dept. of Energy and without their involvement this effort could never have been undertaken.

Why *study* Dixie Valley? There are several very good reasons why Dixie Valley is a logical geothermal system to study in **detail.** The overriding reason is that it appears **to** be a relatively simple geothermal system.

The current knowledge of the system suggests it lies along a single major normal fault (Stillwater fault) or very narrow fault zone depending upon semantics. Knowledge of **this** system **should** have applicability to the majority of fracture dominated reservoirs throughout the world. On a more restricted basis there are literally thousands of kilometers of similar faults in the Basin and Range province that must share a lot of common characteristics with the Still water fault. The Stillwater fault is basically a dip slip fault with little or no complicating strike slip movement.

The geology is very well exposed. To the best of my knowledge it is the **only** geothermal,field where it is possible to stand next to a 3000 m deep geothermal well and look up 500 to 1000 m on the mountainside and see the **reservoir rocks** beautifully exposed. The formations are grossly layer cake, **easily** differentiated **fiom** each other, and have enough structural deformation and complexity to challenge any geologist yet at the end of the day leave a geologist believing he/she has a reasonable understanding of the overall geology.

The hydrology is probably as simple as it gets. There is no large or rapid lateral movement of thermal water through shallow aquifers to complicate matters. In fact, this geothermal reservoir is somewhat unique in the exceptionally small volume of flow (40,000 to 80,000 lbs/hour) through the reservoir in its natural state.

The near **surface** geology above the reservoir is simply a wide, more or less flat valley with alluvium to depths of several thousand feet and probably fairly consistent geology along the strike of the fault. Any topographic corrections here are minimal for a geothermal field.

The surface trace of the Stillwater fault along the producing portion of the reservoir is absolutely straight. It is not complicated by curvature as happens at Beowawe ***or*** by apparent **ends** such as at the Opal Mound fault at Roosevelt.

Lastly the area has an extensive exploration history and a well documented production history aver the past 8 112 years. The efforts of many well known geothermists over **two decades** *can* be found in past reports and memos, the quality of which ranges fiom prophetic to embarrassing.

With the preceding paragraphs in mind, it is logical to ask the question "If this geothermal field is so simple, why put a major effort into studying it?" This can be answered with the use of a few simple statistics. Currently there are 26 wellheads sticking out of the ground in Dixie Valley (no wells have been abandoned). only two of these were drilled with the intent of being something other than a production well. These 26 wellheads overlie an additional 16 redrills giving a total of 42 well legs, the shallowest of which is still greater than 7000 feet. Even if the few redrills for mechanical reasons are discounted about one third of the total well legs in Dixie Valley are redrills. At approximated $1 to 2 million per well or redrill this leaves a substantial stranded expense and brings out the fundamental underlying reason for this session. At $2 million for a single well leg to 3000 m and another million for a redrill we need to have an outstanding batting average to compete with other current forms of energy.

Being most pessimistic, we could say the overall success rate is 10 producing legs out of 42 legs for a success rate of 0.238. Even if we throw in the seven injectors currently in service, the success rate increase to only 0.404. If we had to start from scratch today and try to finance it with a predicted success rate of approximately 40% we would probably have an insurmountable challenge on our hands.

What is the problem? The overall approach to development in hindsight has resembled at various times blind men feeling an elephant, a game of pin the tail on the donkey, and simple closology, which has had the overall beauty of generally working. Again and again when some individual thought they had an acceptable understanding of the geology and reservoir and were brave enough to make predictions about what would be encountered in the next well the result was usually an embarrassed silence. Even with all the previously mentioned "simplicity" of the system there are enough messy little details and unknowns to trip up anyone either lucky enough or foolish enough to have to site a well in this field Seven different companies have stepped up to this challenge in Dixie Valley.

The roots of this particular research effort go back a few years ago when Oxbow drilled a well that produced several unexpected and unpredicted results and completely shook our confidence in our understanding of even the basic geology of the area. As often happens at these times a chance conversation with someone sets in motion a chain of events that takes on a life of its own. This conversation with John Sass regarded implementing a Cooperative Research and Development Agreement with the U. S. Geological Survey to perform in-situ stress measurements in Dixie Valley to try to answer the fundamental question as to why productive fractures can be found in some places but not in others. As planning for this study progressed it became obvious that we needed a better fundamental understanding of the entire reservoir to fill in various gaps in our knowledge and the scope of the research expanded considerably.

The following presentations represent a determined effort to characterize a "simple" fracture dominated geothermal reservoir which is probably going to be proven to have many similarities with most other liquid-dominated, high-temperature, fractured geothermal reservoirs throughout the world.