DRILLING OF GEOTHERMAL WELL FOR GREENHOUSES HEATING AT PANTANI, ITALY

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ABSTRACT

In the area Pantano di Civitavecchia, approximately 80 km NW of Rome several hot springs are encountered. 3 deep boreholes had been drilled before 1983, which proved the geothermal potential of the area. For this reason the Directory General for Energy (DG XVII) of the European Commission supported the drilling of the deep well Pantano II in the framework of the THERMIE programme. The well was drilled in 1983 reaching a depth of 665 m. The geothermal reservoir layed beneath the clay and flysch cover, within the karstic limestones. Production tests indicated that the well yields 68 lt/s of water with temperature of 48°C and salinity of 3 gr/lt. At present 20 ha of geothermal heated greenhouses are in operation in the area utilizing water of 52°C from 6 productions and 2 reinjection wells with corresponding energy savings at 2,000 toe annually.

1. INTRODUCTION

On February 10, 1983, in the framework of the THERMIE program, the contract GE 76/81 was signed between DG XVII and ALBANI E RUGGERI S.s.a. Azienda Floricola, in order to drill a 600 m deep geothermal well at Pantano di Civitavecchia, approximately 80 km NW of Rome.

The project aimed at tapping the geothermal reservoir already identified by the 3 deep wells drilled in the area, in order to heat the greenhouses owned by the Albani firm. These wells indicated that the geothermal reservoir layed in the karstic limestones below the flysch cover at depths between 350 m and 600 m approximately. One of these wells, named as Pantano I borehole, which was located close to the "Sulphur Springs" at Borgo Pantano area, yielded 100 lt/s of self flowing water with temperature 55°C and total salinity 3 gr/lt, at well head pressure 2.5 kg/cm^2.

Thermal manifestations in the area include several hot springs known and used for bathing since Roman times, the most important of which are the following:

- Bagni di Traiano , NE of Civitavecchia
- Ficoncella Spring , NE of Civitavecchia
- Bagnarello , South of Tolfa
- Bagni e Pian Sultano . North of San Severa
- Sulphur Springs , in Borgo Pantano area.

The structural, geochemical and geothermal particularities of the region had already been studied through numerous studies, which indicated that the area neighbouring the flower farm was the most suitable for geothermal exploitation.

In order to site the Pantano II well, a geophysical survey (electric soundings) was carried out. This survey also indicated that the limestones located below the flysch cover are "obviously dislocated and tectonised".

2. DRILLING OF PANTANO II WELL

The well Pantano II was sited 5 km NW of Civitavecchia, 700 m away from the well Pantano I. Drilling operations started in May 1983 and were completed 6 months later, in November 1983. As mentioned above, the contractor was Albani e Ruggeri S.s.a., which has greenhouses installed in the area. This firm provided support to the drilling operations in terms of providing labor, special vehicles such as lorries, bulldozers, cranes, etc, pumps, as well as piping for water.

The following subcontractors were hired:

- CLEIM SpA: for the drilling operations
- CALVINI IMPIANTI sas: for the pumping tests
- COOP. Mediterranea Prospezioni: for in hole logging operations

The well profile, the lithology encountered and the temperature log performed are shown in figure 1. The upper 340 m of the well were drilled in the clay and flysch cover. A 13 3/8" casing was set at 260 m depth. From 341 to 470 m, the limestone reservoir was encountered. Drilling of this reservoir was extremely difficult, as almost total **losses** were encountered and any attempts to seal off the porous formation failed. Finally, the hole was cased by a 9 5/8" liner to 393 m, in order to be able to drill deeper, to a final depth of 665 m. This liner was removed later on.

3. RESULTS

After the completion of the well, production tests were performed initially with the liner in the well and later without it. The final test that lasted 185 hours was conducted with the aid of a 90 hp pump set at 142 m depth within the 13 3/8" casing. The well

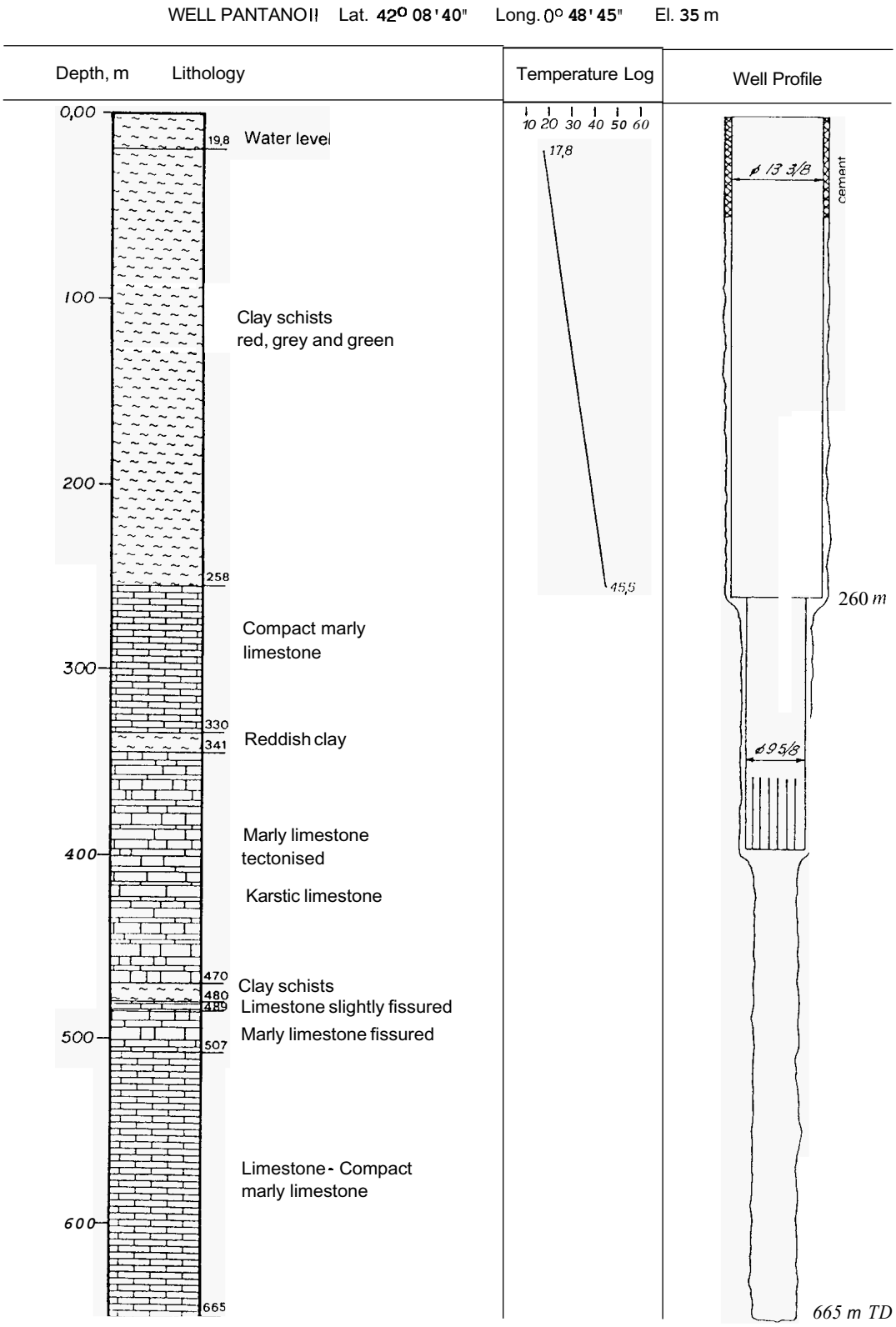

Figure 1. Lithology Log, Temperature Log and Well Profile of the well Pantano II (**ALBANI** E RUGGERI S.s.a.)

produced from an open hole from depth 260 m and deeper, as per figure 1. The production test results were the following:

Water flow rate		68 lt/s
Drawdown		67 m
Water temperature	:	48°C
Water salinity		3 gr/lt

This test confirmed the capability of the well to produce approximately 6.5 MW of heat, which can be used for greenhouse heating.

Following the completion of this project, development of the geothermal field took place. In 1985 the necessary surface equipment and 12 ha of greenhouses were installed. The area covered by the geothermal greenhouses was increased to 20 ha by 1992 resulting in Pantano to become one of the largest geothermal agricultural installations in Europe. The corresponding geothermal energy used amounted at 2,000 toe and over 150 people were employed.

More production wells were drilled during exploitation in order to obtain the necessary flow-rate of 165 lt/sec., increasing therefore the number of production wells to 6. The average temperature of the produced water was 52 °C. In addition, considerable pressure drawdown was observed in the reservoir, as wells with initially artesian flow stood with water level. For this reason two re-injection wells were drilled in an effort to maintain reservoir pressure.

4. CONCLUSIONS

The project was successful. Today 6 production and 2 reinjection wells are in use and the overall flow rate from the tapped reservoir is estimated as 165 lt/s, of 52°C geothermal water.

At present 20 ha of greenhouses are installed, achieving approximately 2,000 toe annual energy savings, while providing jobs for at least 150 people.

During the exploitation, no artesian flow was evident in well P1 any more. As a result, two of the new wells drilled have been scheduled for reinjection in order to maintain the reservoir pressure.

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