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4. *Report of Heat Flow Measurements in San Juan and Mendoza, Argentine.*

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Abstract

Preliminary heat flow measurements, made in 1969, in the Mendoza and San Juan areas in the western Argentine indicate normal values.

Introduction

Preliminary efforts to make heat flow measurements in Argentine were made in 1969. Only an extremely limited area in the central western area of the country, i.e. San Juan and Mendoza, directly east of the Andes, was the area of our study. Wells utilized for our study were all boreholes drilled for the purpose of finding water in the dry land. On the whole, the wells were not open to the depths which would enable our measurements to be really reliable. But noting that no other information is available at the moment, we would like to report on our endeavor in the following. Dr. F. Roberts of "Proyecto de Agua", United Nations, assisted the authors in locating and giving permission to measure the holes. We thank him very much.

In addition to water well data, bottom temperature data from 27 oil wells in the area south of Mendoza has been made available to us. These data appear to give us better information regarding the geothermal gradient. But so far no core samples are available.

San Juan: 31°33′S, 68°31′W

Four water wells drilled into the alluvium at the altitude of about 600 m were visited for temperature measurement on March 31 and April 1, 1969. The holes are No. S-8 (south of San Juan), El Salado No. 27, No. 98 and San Juan No. 194 VT-8, the locations of which are shown in

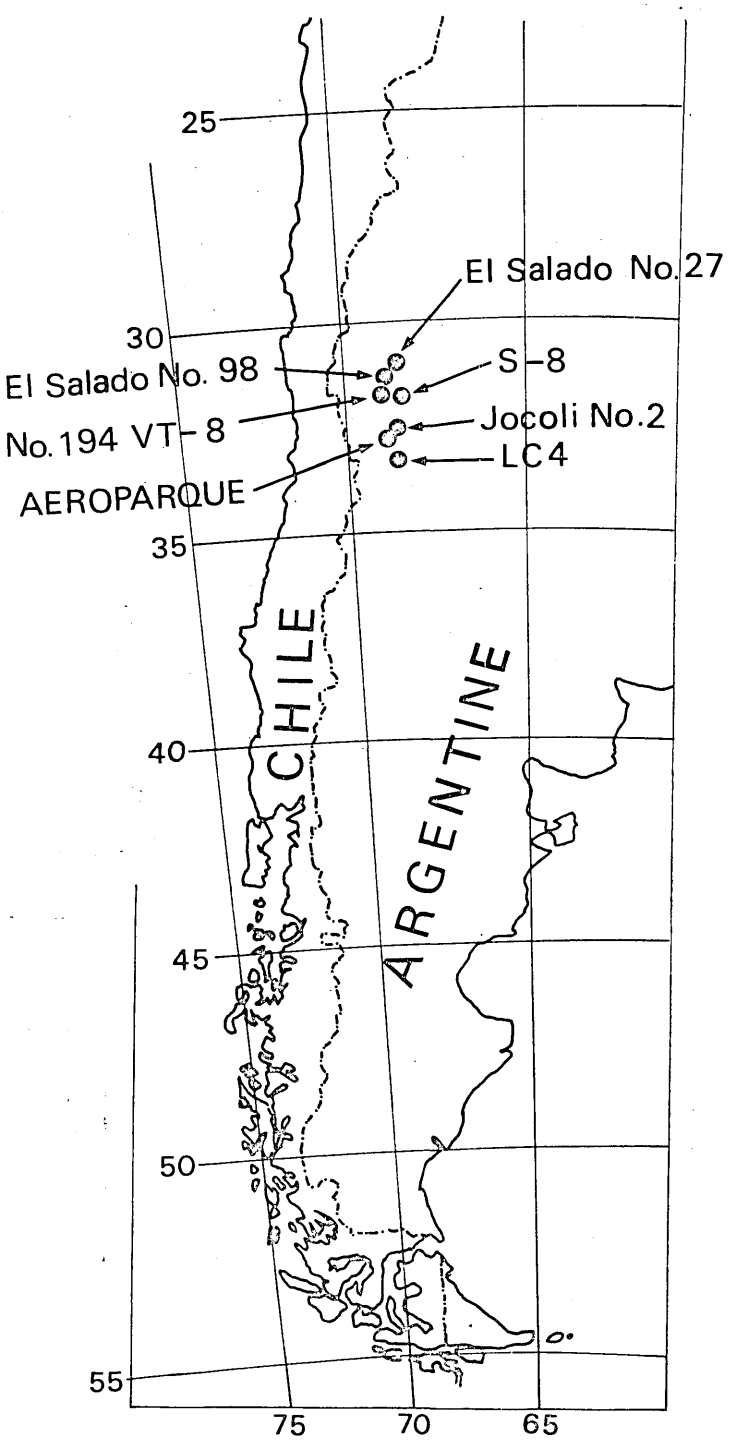

Fig. 1. Locations of water wells used in the present study in the San Juan and Mendoza areas.

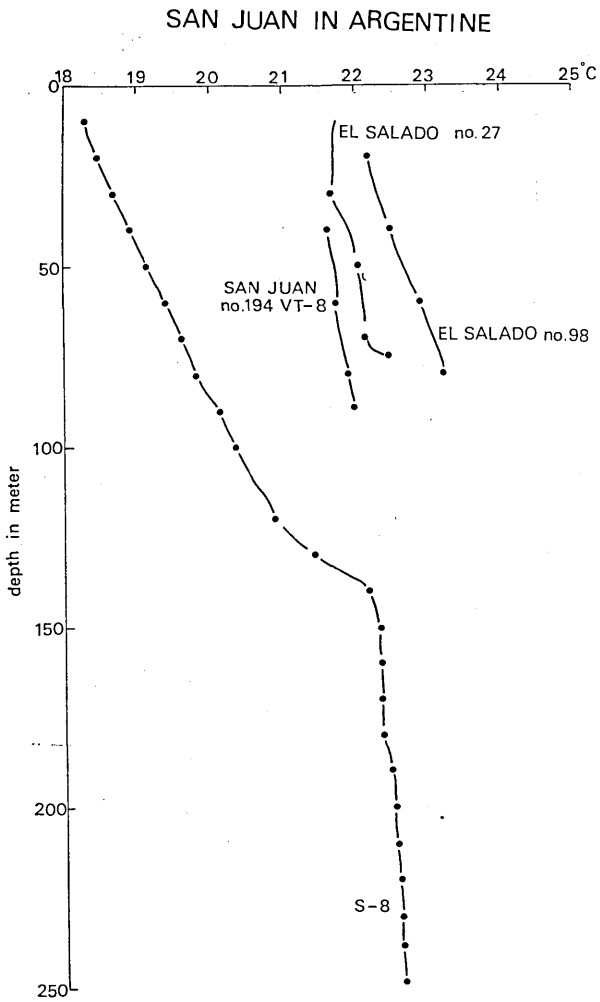

Fig. 2. Temperature-depth relations in the San Juan holes.

Fig. 1. The results of temperature measurements are shown in Fig. 2. It appears that there is a discontinuity in the gradient at the depth 130-150 m (well No. S-8). Among all the holes, hole No. S-8, being 250 m deep, seems to give the best results, all the other holes being too shallow. The gradient above 100 m depth is 2.4×10^{-4}°C/cm, whereas below 150 depth it is of smaller order of magnitude (0.2×10^{-4} °C/cm). It is a difficult problem to decide which of those gradients are meaningful. If the depth of the water table is responsible for the kink in the T-d relation, and heat transfer below the water table is not conductive, the gradient above the kink may be closer to the geophysically meaningful gradient. Here, we tentatively take this view.

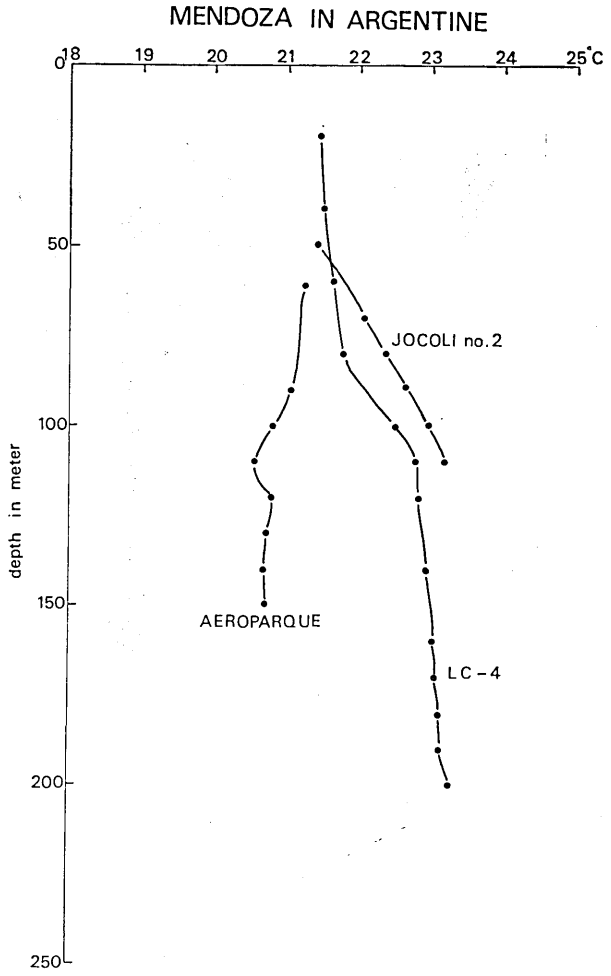

Fig. 3. Temperature-depth relations in the Mendoza holes.

Mendoza: *32°48′S, 68°52′W*

This area is about 150 km south of San Juan and its altitude is 500–600 m above sea level. Three water wells (LC-4, Jacoli No. 2; Aeroparque in Fig. 1) were visited on April, 3-4, 1969 for temperature measurement, the results of which are shown in Fig. 3. Here again, some irregularities in the temperature were encountered at the depth of 80–100 m. In the well Aeroparque, the gradient was negative, indicating the complex nature of the thermal regime. At the well LC-4 the gradient outside the disturbed zone is about 0.49×10^{-4}°C/cm. Although not sufficiently deep, the T-d relation in Jocoli No. 2 well was found to be most linear. If we assume this well represents the geophysically meaningful

Table 1. Temperatures in oil wells, Mendoza

Well	Coordinates (meter from the South Pole)	Depth (m)	Temperature °C
SJ-1	X=6.314.479,22 m Y=2.483.000,72	4.028	113.3
TR-25	X=6.322.881,35 Y=2.491.784,77	2.279	83.3
T-70	X=6.317.327,27 Y=2.493.817,08	2.311 2.877 3.194	90.5 104.9 119.6
M. EI. xp19	X=6.326.218,45 Y=2.493.398,72	3.352 4.484	98.8 144.4
EI-12	X=6.325.589,56 Y=2.494.979,86	2.517 3.057	90.4 110.0
M. PS. x 1	X=6.331.707,49 Y=2.500.486,36	3.839	136.0
M. PC. xp104	X=6.316.892,04 Y=2.495.536,34	3.063 3.708 4.147 4.559	104.4 118.3 132.2 155.5
CH-6	X=6.307.161,49 Y=2.500.984,89	3.257 4.005	110.0 160.0
MCHxp 25	X=6.307.777,56 Y=2.501.033,29	2.993 4.043 4.501 4.650	94.4 132.2 148.8 159.4
M. BO. x 2	X=6.329.383,80 Y=2.513.580,80	2.973 3.391 3.727 3.898	110.0 104.4 123.8 132.2
M. BN. a-1	X=6.337.877,38 Y=2.519.652,99	2.615	81.2
M. ECP. x-4	X=6.341.380,24 Y=2.518.302,72	2.231 2.992	67.2 90.5
M. EOP. e-5	X=6.343.638,03 Y=2.517.561,48	2.416 3.078 3.597	85.0 90.5 103.3
B-153	X=6.327.245,66 Y=2.521.411,02	2.634	104.4
LC-79	X=6.323.967,88 Y=2.525.442,44	2.480	94.4
LC-80	X=6.324.161,56 Y=2.525.742,30	2.483	83.3
LV-80	X=6.312.055,44 Y=2.527.313,06	2.379	88.8
VM-86	X=6.298.440,21 Y=2.534.149,60	2.447	112.2
VM-146	X=6.294.183,19 Y=2.538.949,30	2.392	110.0
PB-133	X=6.291.173,38 Y=2.531.246,07	2.315	94.4
M. Vi a 4	X=6.287.177,00 Y=2.553.315,69	1.966 2.519	68.8 81.2

(to be continued)

Table 1. (Continued)

Well	Coordinates (meter from the South Pole)	Depth (m)	Temperature °C
Vi x-3	X=6.288.235,25 Y=2.553.848,85	2.666	110.0
LJ x-1	X=6.279.592,96 Y=2.556.680,52	1.857 2.702	87.7 104.4
M. AV. x-6	X=6.298.036,42 Y=2.518.038,48	2.771 3.073	105.5 108.8
M. N. x-1	X=6.232.938,52 Y=2.600.797,01	3.106	108.8
K. LT. x-1	X=6.234,021,07 Y=2.673.938,37	2.460	90.5
M. LTO. es-1	X=6.235.934,50 Y=2.666.848,33	1.773 2.492	71.1 95.5

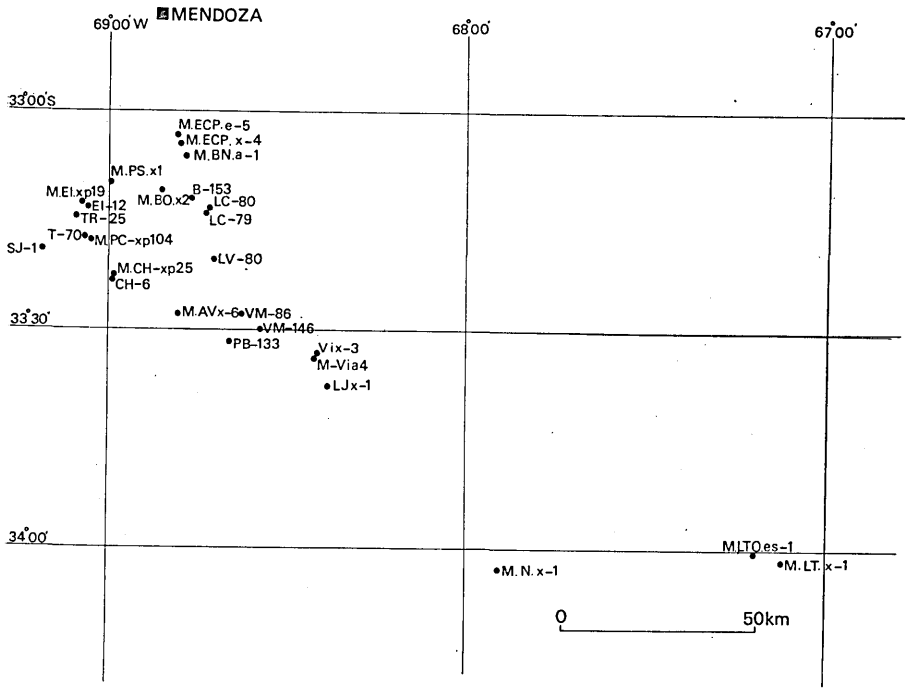

Fig. 4. Locations of oil wells in the Mendoza area.

gradinet best, the gradient is 3.1×10^{-4}°C/cm. We thank Sr. A. David of Plan Agua Subterranea for his assistance in temperature measurement.

Heat Flow

As seen from Fig. 2 and 3, the T-d relations measured are disturbed and it is hard to infer the true geothermal gradient. One fine silt speci-

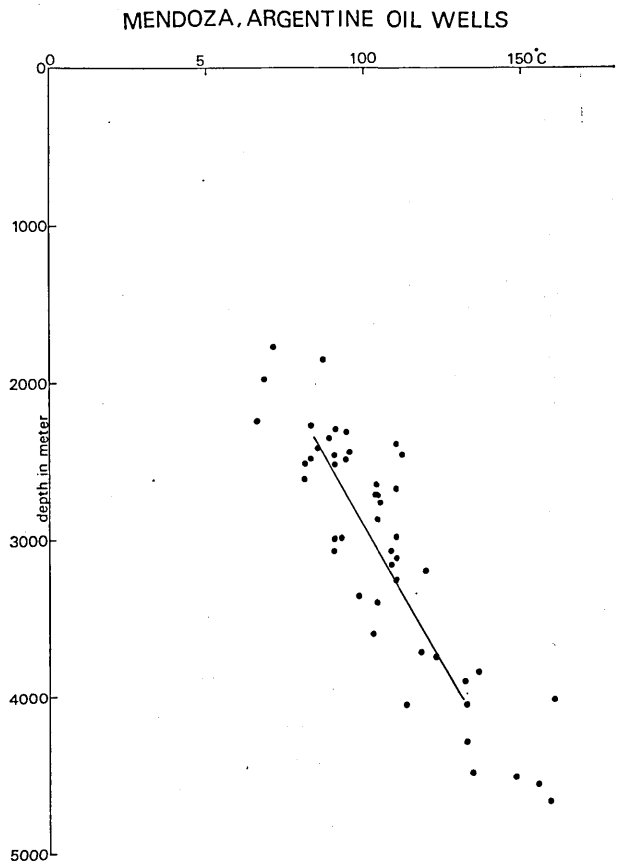

Fig. 5. Bottom hole temperature of the oil wells in the Mendoza area.

men, which is believed to be representative of the alluvium concerned was made available for the thermal conductivity measurement. The conductivity value measured was 2.08×10^{-3} cal/cm sec °C (dry) and 3.13×10^{-3} cal/cm sec °C (wet). Taking the value under dry condition, the tentative heat flow value would be 0.5 HFU for San Juan and 0.6 HFU for Mendoza, respectively.

Oil Well Data:

On the other hand, quite a few temperature data from the oil field in the Mendoza area were given to us by Yacimientos Petroliferos Fiscales. The data are shown in Table 1 and the locations of wells are shown in Fig. 4. Not knowing the exact conditions under which the temperature were measured in these wells, we have plotted the temperatures against the depth as shown in Fig. 5. This seems to give a thermal gradient of

2.9×10^{-4}°C/cm. Considering the great depth of T-data where the strata are composed of either metamorphic and intrusive basement (personal communication from Juvenal Zambrano of San Juan University), the thermal conductivity may be assumed as 5×10^{-3} cal/cm sec °C, giving the heat flow value of 1.5 HFU.

Remarks

As mentioned already, the reliability of the data taken from water wells in San Juan and Mendoza area must be considered to be low. Therefore, further study is most definitely needed. Temperature data from the nearby oil wells may represent more significant values. However, we have no conductivity measurement on oil well specimens.

With the present scanty data, the authors feel that it would be likely that the higher heat flow value from oil wells is closer to being representative of the region.

Acknowledgment

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4. アルゼンチン西部サンファン，メンドーサ地域における地殻熱流量測定

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1969年，アルゼンチン西部サンファン，メンドーサ地域で行なった地殻熱流量測定結果を報告する．アンデス東側のこの地域では浅い水井戸しか使用できず，見掛上の熱流量値は低く（~0.5 HFU）得られたが，信頼度はひくい．一方，メンドーサ地区の深い石油井戸からのデータによると熱流量は世界平均値に近い（~1.5 HFU）可能性がある．後者の方が真の値に近いと考えられる．
