MINISTÉRIO DAS MINAS E ENERGIA

NATIONAL DEPARTMENT OF MINERAL PRODUCTION
POTASSIUM PROJECT

S U MMA R Y

By Decree 61.157, of August 16th, 1967, the government awarded to the National Department of Mineral Production the exclusive right to prospect for Rock and Potassium Salts in an area of about 500 square kilometers in the State of Sergipe, in order to determine the economic value of the salt ore deposits there existing.

2. The Final Report has been presented to the DNPM General Director and it consists, briefly, of seven volumes, as outlined below:

Vol. I - Text, with XIX Chapters, including that of CONCLUSIONS and RECOMMENDATIONS.

Vol. II- ILLUSTRATIONS, with 28 maps, geological sections and composite profiles (30% of the drilled wells).

Vol.III- Major Sampling - detailed description of the samples mainly the sylvinite.

Vol. IV- Analytical Results - Optical Mineralogy. Thin Sections. Mineralogical Compositions. It concerns about the chemical composition of the soluble salts, their optical properties and the calculation of the mineralogical composition.

Vol. V - Sampling for bromine. Bromine Determination. The halites of some wells were examined for bromine, enabling the obtaining of some complete profiles of bromine concentrations, which appear in the composite profiles in the Vol.II.
Two albuns of coloured photos taken from the salt cores are attached in the Final Report. It includes photographs of the sylvinite cores of all wells.

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3. Two basic mineral resources were evaluated in the area under study: SYLVINITE (a mixture of sylvite and halite, sodium chloride), as the principal potassium ore, and TACHHYDRITE (calcium and magnesium double chloride), as the main magnesium ore.

Two other minerals, CARNALITE (potassium and magnesium double chloride) and ROCK-SALT (sodium chloride) were also evaluated.

4. Two potassium ore bodies (SYLVINITE) were located at the subareas of Sta.Rosa de Lima and Taquari-Jurema-Vassouras.

5. The sylvinite ore deposits of the Santa Rosa de Lima subarea were evaluated in 100 millions tons in place, with an average grade of 25,45% of K_2O and average thickness of 4,2 meters at depth, ranging from 500 to 900 meters below sea level. The sylvinite bed is between two thick halite layers.

6. The chief sylvinite deposits of the Taquari-Jurema-Vassouras subarea are evaluated in 350 millions tons in place with an average grade of 23,95% of K_2O and an average thickness of 6 meters. The thickest sylvinite is found in the PKC-7 and in the areas nearby. The average depth of the ore body is 500m.

7. The estimated reserves of tachhydrite and carnallite, only in the Taquari-Jurema-Vassouras area, in place, amount to 4 and 6 billion tons, respectively. In view of the potentiality of these deposits, the "Departmento Nacional da Produção Mineral" asked the Battelle Institute, Columbus, Ohio, to study the feasibility of their utilization. As a result of this research work a Special Report was prepared which shows the possibility of utilization of tachhydrite as a source for magnesium chloride production.

A similar step was taken, by the DNPM, with the Hazen Research Inc. Laboratory, Golden, Colorado, aiming at another aspect of the technical-economical feasibility of tachhydrite

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utilization, perhaps together with carnallite. The result of this research is being expected at the end of August, 1970.

8. The estimated reserves of rock-salt, located in a rectangular area of 7,5 x 1,0km, limited by PKC-10, PKC-6 and PKC-14 wells, amount to 525 millions tons in place.

9. The report considers the estimates for potassium chloride fertilizer consumption in the country, in 1978, to be in the order of 500/600 thousand tons, which would require a sylvinite mine with a capacity of 7.000 tons/day of ore production. The process of mining has not yet been chosen, whether solution or convencional mining.

10. The report states that, due to the peculiar stratigraphic situation of sylvinite beds, the Santa Rosa de Lima area seems to be the best suited for opening the first mine, but the location for the ore Processing Plant has not yet been decided and would be in charge of the mining company, responsible for the mining operation.

11. The Taquari area seems to be the best for solution mining of the Tachhydrite or even of the Carnallite, aiming at magnesium production.

12. In order to obtain more geological data to complete the knowledge of the ondulation behaviour of the sylvinite ore bodies to allow the engineering mining design for the potassium deposit, a development program should be scheduled, including additional slim hole drilling and perhaps directional holes.

While this program were performed, the industrial infrastructure of the area would be investigated in order to provide a background for industrialization of those mineral resources.

It is known through the drillings carried out in the Santa Rosa de Lima area that there exists large quantities of

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underground fresh water.

13. According to PETROBRÁS, the area of the deposits is free for mining work, although it is close to the three largest Sergipe oil fields (Carmópolis, Siririzinho e Riachuelo). On account of that, possible problems from gas, in the mines are to be expected; however this will be technically controllable. A third area of sylvinite, though of secondary value was evaluated, in a stratigraphic level below the first one, occurring at the top of the thick carnallite layer, in the Taquari area, which penetrates through the northeast flank of Siririzinho oil field, with at least one-third of its reserve, estimated in about 100 millions tons in place, within this field.

14. It is also worthwhile mentioning that Schlumberger has performed for DNPM, the IBM processing of all the radioactive and electric logs of the 21 wells drilled by the Project, aiming to determine the K_2O and MgO amounts in ton/m^3.

15. The basic elements for the Final Report are filed in Rio Office of the Project as well as the originals of the illustrations shown in Vol.I, and the originals of volumes I, III, IV and V, and, in Aracaju, are the originals of illustrations of Vol.II as well as the negative of the color pictures which are shown in the two volumes of photos.

The reports obtained by the Potassium Project, general information and specially the reports by Battelle and by the Brazilian Geophysic Company's on Electroresistivity are filed in the DNPM-Rio Office.

16. The salt core samples, wrapped in polyethyene cartridges and the samples prepared in laboratory for further investigation, including petrographic studies and ore dressing treatment are also kept in Aracaju.

17. A scheduled program for studying this material has been prepared by the Project Technical Rio staff and approved by the General Director to be carried out, by the technical

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personnel which is still working in Aracaju.

18. It is worthwhile saying that the universally recognized consultants - Dr.Richter Bernburg, Vice-President of German Geological Service, geologist Robert Hite from the "United States Geological Survey" and Mr. J.Purser Smith, pioneer in the American Potassium Industry and more recently Prof. N.Wardlaw have contributed with studies and recommendations for the Project accomplishment.

19. Finally, due to the importance of the subject from the economical standpoint some comments should be made about the salt disturbance, of the Ibura member, Muribeca formation, which may in some way affect the mining of the sylvinite ore. There are undoubtedly strong deformations in some layers of the soluble salts. These deformations are, occasionally, followed by absence of some stratigraphic layers. In Santa Rosa de Lima area, for instance, the halite layer above the marker number 12 (anhydrite) displays intensive deformations, contemporaneous of the deposition, probably due to dissolution effect. The lower part of this halite, down to the main sylvinite zone, shows uniform and gentle dips, averaging 5º. But, the difference of the structural level of this main sylvinite among the wells, in the area thought to be economically worthwhile to mine, with about 100 millions tons of sylvinite, is of 400 meters. As far as we know from the available data, this may be explained by faulting due to differential subsidence, which may have remained active, in some areas, even during the Aptian time.

So the behaviour concenning the structural or the simple disturbance of the sylvinite mineable zone is of extreme importance for the future mining.

20. In Sergipe Basin, the geologist of Petrobrás,although believing that the halocinese is not an important geological

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phenomenum in its salt basin, recognize that there some faulting occurs even in Eocene time, but not so intense as in the Lower Cretaceous, pre-Muribeca time.

I L U S T R A Ç Õ E S

I) - Área Reservada ao Desenvolvimento das Jazidas petrolíferas de Treme - Riachuelo -Sirirrizinho (Dexpro 38.120/68) e de Carmópolis(Dexpro 3/30 DGCB - 383/3393/65) - Planta de situação da área da Reserva Nacional em relação a Aracaju, Capital do Estado de Sergipe (Esc. 1:250.000).

II) - Planta de Situação da Silvinita de Taquari - Vassouras e Santa Rosa de Lima.

III) - Seção Geólogica do VA-2-SE ao PKC-3 - (Vassouras-Taquari-Miranda).

IV) - Planta de Situação de Isolitos, das Carnalitas - (Área de Taquari - Vassouras).

V) - Planta de Situação de Isolitos das Taquidritas - (Área de Taquari - Vassouras).

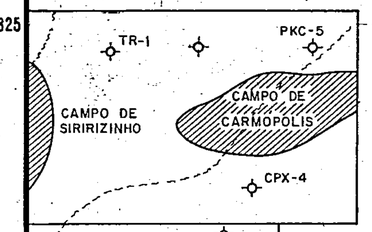
VI) - Seção Geólogica dos Poços PKC-23 ao PKC-26 da Área de Santa Rosa de Lima.

PETRÓLEO BRASILEIRO S.A. — PETROBRÁS

ÁREA RESERVADA AO DESENVOLVIMENTO E PROTEÇÃO DAS JAZIDAS PETROLÍFERAS DE TREME - RIACHUELO - SIRIRIZINHO

ESCALA 1:100 000

ANEXO DO DEXPRO 38.120/69 de 7/11/69



ESC: 1:250.000

685 690 695 700 705 710 715 720 725 730

830 825 820 815 810

37°15'15" 34°05' 10°50' 36°55'00" 10°35'12" 10°42'00"

SIRIRIZINHO CARMÓPOLIS RIACHUELO TREME ARACAJU MARUIM VARZEA DA FLÔR

SIRIRI JAPARATUBA ROSÁRIO DO CATETE SÃO JOSÉ RIACHUELO

Linha de "pinchout" da zona de sal

Linha limite do Campo / Faixa de segurança (BRASILEC)

FEDERAL FERREA VIAÇÃO RIO Japaratuba

9-PKC-25 3-SZ-7 9-PKC-2 9-PKC-3 1-SEM-1 9-PKC-24 1-CL-1 3-SZ-8 9-PKC-12 9-PKC-1 4-CSI-1 3-SZ-5 9-PKC-10 1-PM-1 TQ-1 3-CP-15 3-SZ-52 3-SZ-54 1-JT-1 1-SI-1 3-SZ-10 3-SZ-3 3-SZ-46 9-PKC-9 9-PKC-6 2-SJST-1 9-PKC-21 9-PKC-22 3-SZ-51 9-PKC-17 1-SZ-1 3-SZ-6 3-SZ-49 7-SZ-71 3-SZ-2 3-SZ-13 CPX-5 A CPX-2 CPX-1 I-SRL-2 9-PKC-18 9-PKC-26 9-PKC-19 3-SZ-4 9-PKC-23 3-SZ-14 3-SZ-56 9-PKC-8 9-PKC-7 9-PKC-16 4-ROX-2 1-SRL-1 9-PKC-15 9-PKC-14 1-AGN-1 3-SZ-12 3-SZ-11 3-CPX-5 9-PKC-20 3-ME-2 324-A-53-40 342-D-52-40 B 1-JU-1 1-LI-1 3-RO-7 1-ME-1 3-RO-18 4-SZ-59(9-PKC-11) 3-AG-2 3-RO-9 3-RO-5 3-RO-22 4-MG-4 3-SZ-74 351-G-53-40 1-CV-1 3-CPX-4 3-CPX-6 4-CPS-1 1-AG-1 3-AG-3 3-RO-21 9-PKC-13 3-AG-4 1-VA-2-SE 1-NTR-1 3-RO-12 3-RO-6 1-DP-1 1-SB-1 1-VA-1 2-RCST-1 1-CPF-1 1-UC-1 3-RO-4 1-PL-1 3-RO-10 3-RO-8 3-RO-11 1-FA-1 RO-2 1-RO-1 3-RO-3 3-VF-7 1-AS-1 3-TR-3 3-TR-4 1-TR-1 3-RO-17 3-TR-2 3-TR-5 1-PU-1 1-PU-2 1-QS-1 1-FR-1 1-PB-1 3-VF-6 3-VF-3 1-VF-1 3-VF-5 3-VF-2 1-PB-2 1-SAB-1 3-VF-4 4-JI-1 C 1-BR-1 1-CAB-1-SE

I

Campo de Carmópolis (Dexpro 3/30 DGCB 383/3393/65 de 10/12/65)

Campos de Treme-Riachuelo-Siririzinho (Dexpro 38.120/69 de 7/11/69)

Área da Reserva Nacional de Sais de Potássio e Sal Gema (Decreto 61.157 de 16/8/67)

MINISTÉRIO DAS MINAS E ENERGIA

DEPARTAMENTO NACIONAL DA PRODUÇÃO MINERAL

PROJETO POTÁSSIO

PLANTA DE SITUAÇÃO DA SILVINITA DE TAQUARI-VASSOURAS E S. ROSA DE LIMA

LINHA DO PINCHOUT DA ZONA DE SAL

LIMITE DA AREA DE PROTEÇÃO DAS JAZIDAS DE PETRÓLEO

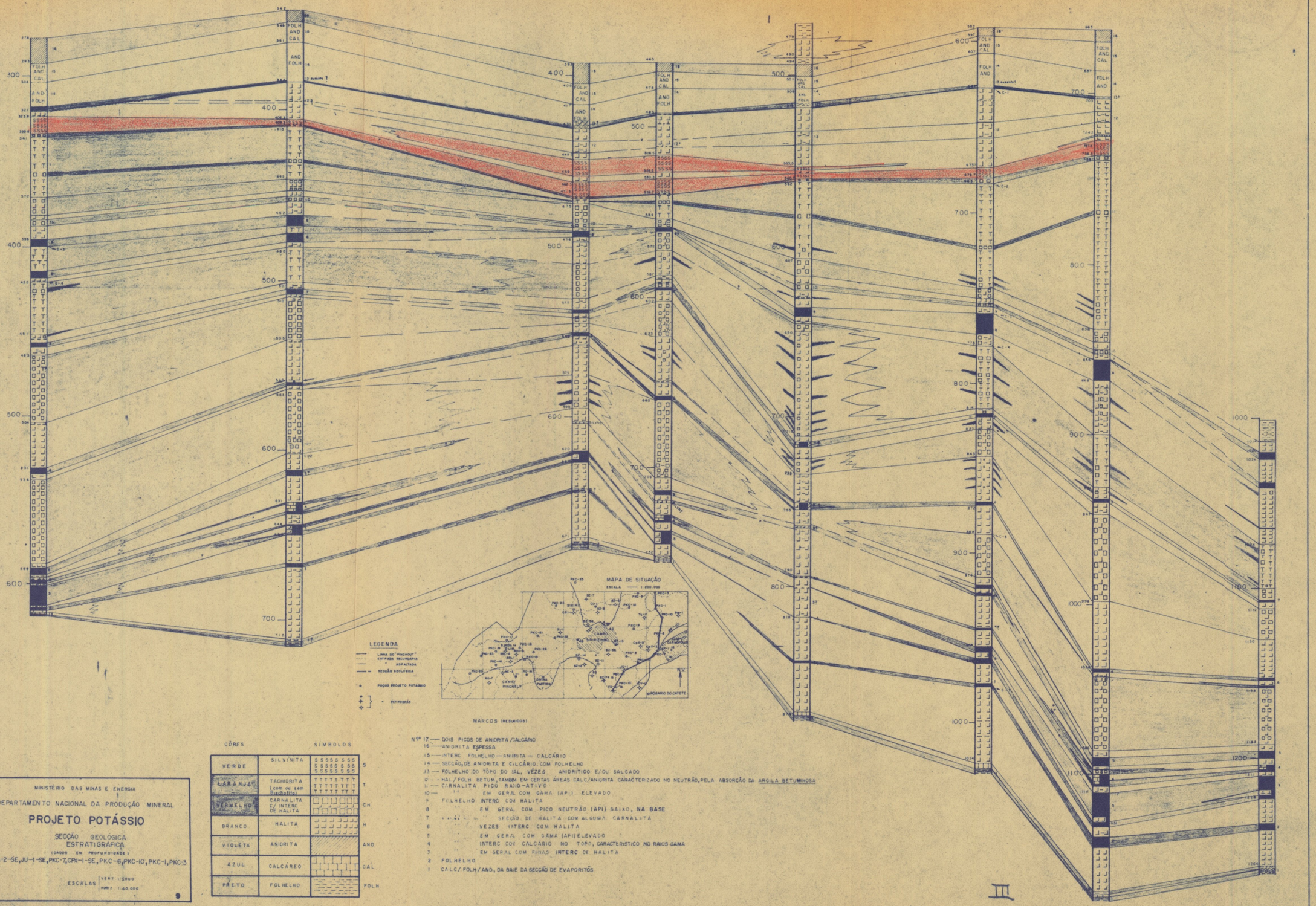
ESPESSURA DA SILVINITA TOTAL

ESPESSURA DA SILVINITA COM TEOR MINERÁVEL NA CAMADA PRINCIPAL

ESCALA: 100.000

II

VA-2-SE MR+26 — 2.9 Km — JU-1-SE MR+45 — 3.5 Km — PKC-7-SE MR+28.68 — 1.6 Km — CPX-1-SE MR+45.2 — 1.65 Km — PKC-6-SE MR+39.31 — 2.22 Km — PKC-10-SE MR+112.66 — 1.4 Km — PKC-1-SE MR+144.93 — 2.0 Km — PKC-3-SE MR+147.85



MAPA DE SITUAÇÃO
ESCALA — 1:200.000

LEGENDA
- LINHA DO "PINCHOUT"
- ESTRADA SECUNDÁRIA
- * ASFALTADA
- SECÇÃO GEOLÓGICA
- POÇOS PROJETO POTÁSSIO
- PETROBRÁS

MARCOS (RESUMIDOS)

Nº 17 — DOIS PICOS DE ANIDRITA/CALCÁRIO
16 — ANIDRITA ESPESSA
15 — INTERC FOLHELHO — ANIDRITA — CALCÁRIO
14 — SECÇÃO DE ANIDRITA E CALCÁRIO COM FOLHELHO
13 — FOLHELHO DO TÔPO DO SAL, VÊZES ANIDRÍTICO E/OU SALGADO
12 — HAL/FOLH BETUM, TAMBÉM EM CERTAS ÁREAS CALC/ANIDRITA CARACTERIZADO NO NEUTRÃO, PELA ABSORÇÃO DA ARGILA BETUMINOSA
11 — CARNALITA PICO RAIO-ATIVO
10 — " EM GERAL COM GAMA (API) ELEVADO
9 FOLHELHO INTERC COM HALITA
8 " EM GERAL COM PICO NEUTRÃO (API) BAIXO, NA BASE
7 " SECÇÃO DE HALITA COM ALGUMA CARNALITA
6 " VEZES INTERC COM HALITA
5 " EM GERAL COM GAMA (API) ELEVADO
4 " INTERC COM CALCÁRIO NO TOPO, CARACTERÍSTICO NO RAIOS GAMA
3 " EM GERAL COM FINAS INTERC DE HALITA
2 FOLHELHO
1 CALC/FOLH/AND, DA BAIE DA SECÇÃO DE EVAPORITOS

CÔRES		SIMBOLOS	
VERDE	SILVINITA	SSSSSSSS SSSSSSSS SSSSSSSS	S
LARANJA	TACHIORITA (com ou sem Bischofita)	TTTTTTTT TTTTTTTT TTTTTTTT	T
VERMELHO	CARNALITA C/ INTERC DE HALITA		CH
BRANCO	HALITA		H
VIOLETA	ANIDRITA		AND
AZUL	CALCÁREO		CAL
PRETO	FOLHELHO		FOLH

MINISTÉRIO DAS MINAS E ENERGIA
DEPARTAMENTO NACIONAL DA PRODUÇÃO MINERAL

PROJETO POTÁSSIO

SECÇÃO GEOLÓGICA ESTRATIGRÁFICA
(DADOS EM PROFUNDIDADE)
VA-2-SE, JU-1-SE, PKC-7, CPX-1-SE, PKC-6, PKC-10, PKC-1, PKC-3

ESCALAS VERT 1:2000 HORIZ 1:40.000

9

II

III

MINISTÉRIO DAS MINAS E ENERGIA

DEPARTAMENTO NACIONAL DA PRODUÇÃO MINERAL

PROJETO POTÁSSIO

PLANTA DE SITUAÇÃO DE ISOLITOS (APROX.) DAS CARNALITAS (IMPURAS)

LINHA DO PINCHOUT DA ZONA DE SAL

LIMITE DA ÁREA DE PROTEÇÃO DAS JAZIDAS DE PETRÓLEO

ESCALA 100.000

IV

MINISTERIO DAS MINAS E ENERGIA

DEPARTAMENTO NACIONAL DA PRODUÇÃO MINERAL

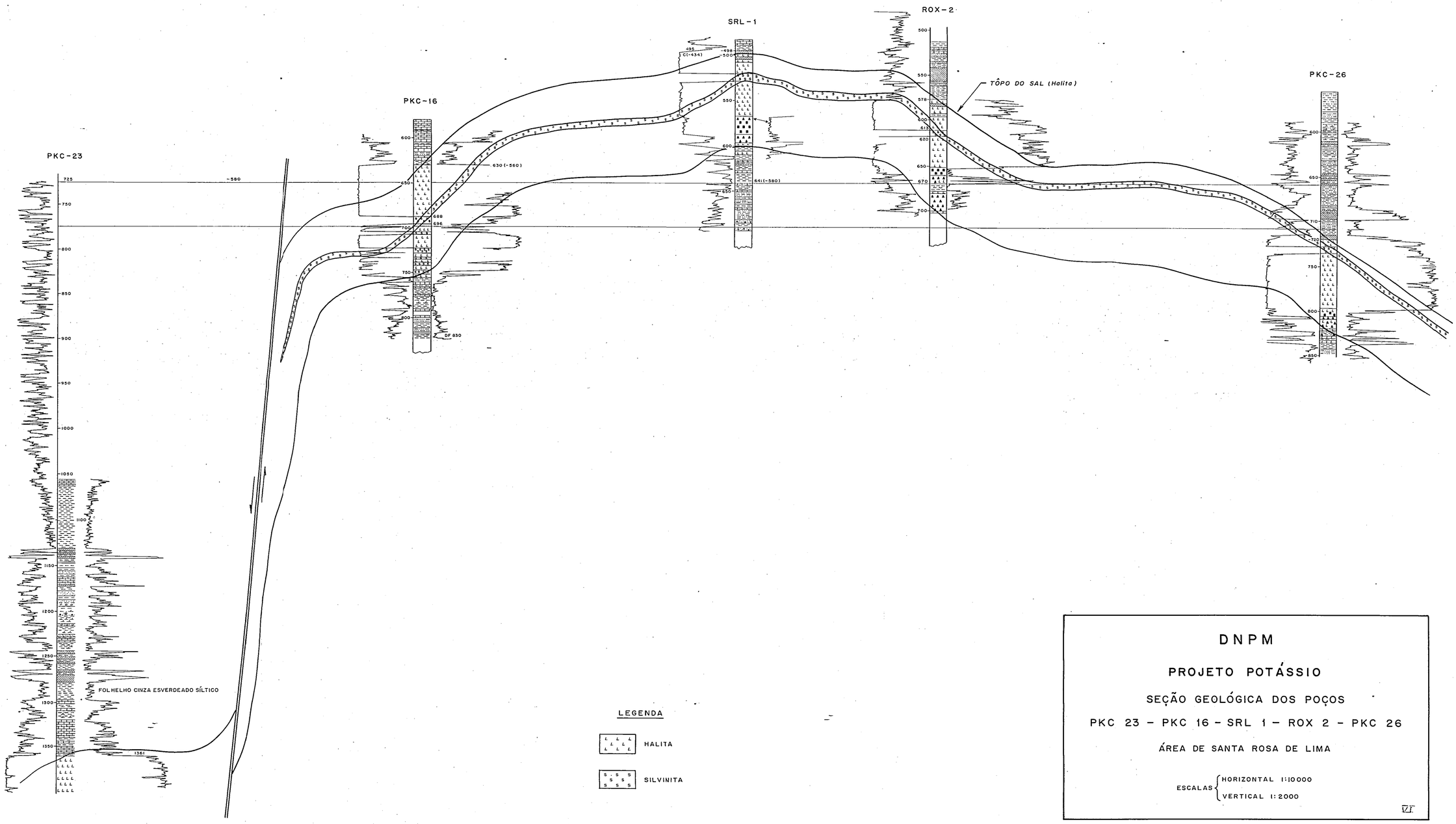
PROJETO POTÁSSIO

PLANTA DE SITUAÇÃO DE ISOLITO DAS TAQUIDRITAS

LINHA DO PINCHOUT DA ZONA DE SAL

LIMITE DA ÁREA DE PROTEÇÃO DAS JAZIDAS DE PETRÓLEO

ESCALA 1:100.000



LEGENDA

HALITA

SILVINITA

DNPM

PROJETO POTÁSSIO

SEÇÃO GEOLÓGICA DOS POÇOS

PKC 23 - PKC 16 - SRL 1 - ROX 2 - PKC 26

ÁREA DE SANTA ROSA DE LIMA

ESCALAS { HORIZONTAL 1:10000
VERTICAL 1:2000

FIG. 7