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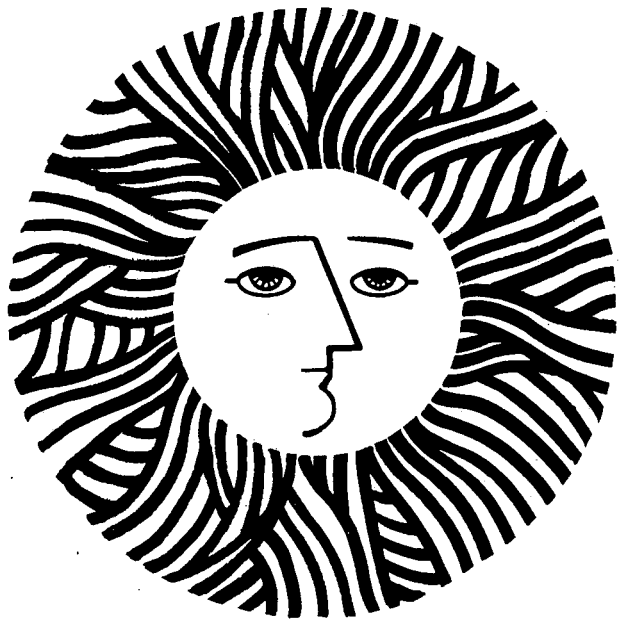

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August 24, 1981

TO: Charles Grua, Brian Harney, and Art Hartstein

FROM: Peter Persoff, Bill Hall, and Mohsen Mehran

RE: Monthly Progress Report for July
Control Technology for In-Situ Oil Shale Retorts
LBID-433

PRESENTATIONS AND PUBLICATIONS

The paper on hydraulic cement production from spent shale by P. K. Mehta and P. Persoff, published in Cement and Concrete Research (v. 10 p. 545, 1980), has been published in translation in the Polish journal Cement-Wapno-Gips (v. 12 p. 331, 1981).

TASK 3. BARRIER OPTIONS

Permeability Measurements on Spent Shale Grouts

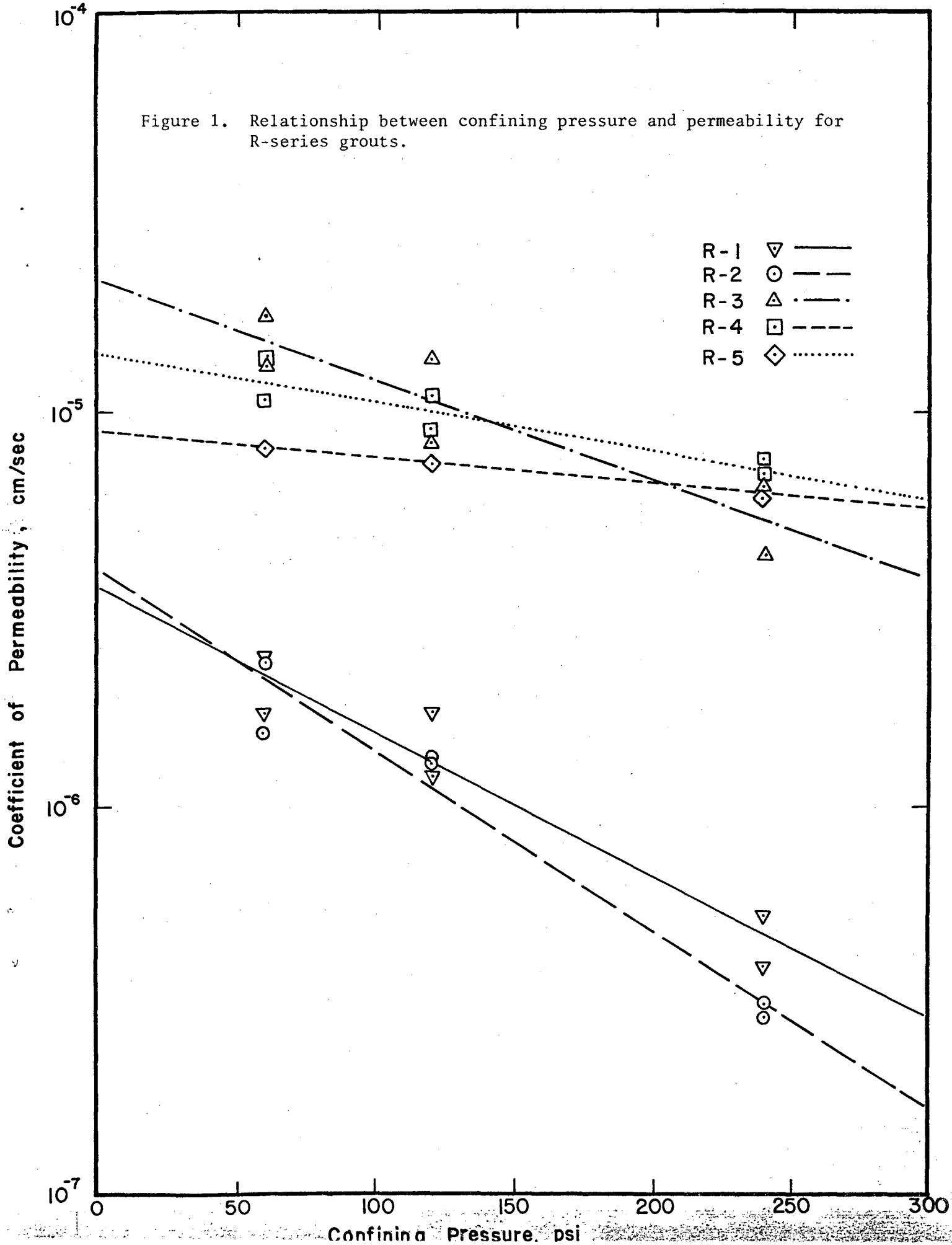
Permeability measurements have now been completed on two specimens each of grouts R-1 through R-5. Formulae of these grouts are shown in Table 1 and results of permeability measurements at three confining pressures are shown in Figure 1. Two different lignosulfonate fluidizers, CZ-503 and CA-512, were used to achieve desired fluidity without bleeding. As shown in Figure 1, grouts R-1 and R-2, using CZ-503, were less permeable than grouts R-3 through R-5, which used CZ-512. This effect was unexpected and the reason for it is not known. Analysis of the fluidizers and microscopic examination of the cured grouts are planned to attempt to explain this effect.

Grouts R-4 and R-5 contained 10% fly ash. This increased the unconfined compressive strength, as shown in Table 1, but had little effect in reducing permeability, as shown in Figure 1. The lines for these two grouts in Figure 1 are flatter than those for the other grouts. This indicates that their greater strength and stiffness reduces consolidation and thus reduces the effect of confining pressure on permeability.

Table 1. Formulae of Experimental Grouts.

	R-1	R-2	R-3	R-4	R-5
Lurgi Spent Shale, g	100	100	100	90	90
Craig Fly Ash (Class F), g	0	0	0	0	10
Wyodak Fly Ash (Class C), g	0	0	0	9.5	0
Gypsum, g	0	0	0	0.5	0
Lignosulfonate Fluidizer, C2-503	0.50	0.25	0	0	0
Lignosulfonate Fluidizer, C2-512	0	0	0.25	0.25	0.25
Water	69.7	74.8	71.8	69.1	63.5
Unconfined Compressive Strength, psi	93	77	59	203	130

Figure 1. Relationship between confining pressure and permeability for R-series grouts.



TASK 5. LEACHING OPTIONS

Analysis of leachate from large column experiments.

Several samples taken during the large column leaching experiments have been analyzed for inorganics and a single sample has been analyzed for organics. We gratefully acknowledge the work of Dr. Amos S. Newton in performing the organic analysis. Methods and results of analysis are described below.

Inorganic analysis. Standard methods for water and wastewater were used: metals were determined by atomic absorption, carbonates by titration, and sulfate by turbidimetry. The major ions were sodium and sulfate which accounted for 85% of the dissolved inorganics 10 hours into the run and 60% 10 days into the run. Results of the analyses are being reviewed. The measured anions exceeded the cations. We suspect that the sulfate results may be high; sulfates are determined by acidification, precipitation, and turbidimetry, and other substances may have also been precipitated.

Organic analysis. Organics were determined by gas chromatography and mass spectrometry (GC/MS) on hexane extracts of the water. The sample was first spiked with an internal standard of three deuterated compounds at 50 ppb each. It was then made basic and extracted with hexane to remove neutral and basic constituents. The residue was methylated and re-extracted. The two extracts were concentrated to 5 mL using a rotary vacuum evaporator and the two concentrated extracts were then analyzed using a Finnigan model 4023 GC/MS. A blank of organic free water was carried through the same procedure. Compounds found in the leachate are shown in Table 2.

TASK 6. GEOHYDROLOGIC MODIFICATION

Solute transport model development

The problem of handling a sharp concentration front moving through the flow medium has been solved by use of an upstream weighting function. This function has been successfully applied both to the porous media and fracture flow. A sample problem of 1-dimensional solute transport was solved analytically, and numerically with and without the weighting function. The solution without the weighting function showed instability in the results; while the weighting function gave a solution that was stable and agreed well with the analytic solution.

Table 2. Compounds Found in Spent Shale Leachate.

Compound	Concentration, ppb
Phenol	5
o-cresol	3
p-cresol	2
2,6 dimethyl phenol	2
Methyl-ethyl phenol	0.7
Trimethyl pyridine	2
Dimethyl ethyl pyridine	1
Dimethyl ethyl pyridine	0.5
Unidentified alkyl pyridine	0.3

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