Title
CONTROL TECHNOLOGY FOR IN-SITU OIL SHALE RETORTS. MAY MONTHLY REPORT

Authors
Persoff, Peter
Ratigan, Joe
Mehran, Mohsen
et al.

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Lawrence Berkeley Laboratory
UNIVERSITY OF CALIFORNIA

ENERGY & ENVIRONMENT DIVISION

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LAWRENCE BERKELEY LABORATORY
Room: 128 Bldg.: 70 Ext.: 6271

June 19, 1980

TO: Charles Grua, Brian Harney and Art Hartstein

FROM: Peter Persoff, Joe Ratigan, Mohsen Mehran, and Phyllis Fox

RE: May Monthly Report
Control Technology for In-Situ Oil Shale Retorts
LBID-237

TASK 3. BARRIER OPTIONS

Development of cementitious properties in spent shale.

A program to develop cementitious properties in spent shale by heating it under controlled atmospheres is in progress. Lurgi spent shale and dolomite (as a control) have been heated in a tube furnace at temperatures ranging from 800 to 950°C in evolved CO_2 and in flowing N_2 gas. X-ray diffraction patterns have been taken on the products and are being interpreted.

Testing of grouted core samples.

Unconfined compressive strengths of some of the grouted core samples have been measured. Slow loading rates (10-20 lb/min) were applied so the time to failure would be about 20 minutes. Sample Q-0 (no cement added) had a strength of 32 psi, indicating that untreated Lurgi spent shale has low cementing strength (not enough to measure by ASTM C-109). Sample Q-1, with 2½ percent portland cement and a different water-solids ratio, had a strength of 85 psi. Strengths of other samples made with Lurgi spent shale cement will be available next month.

A device to measure the electrical conductivity of samples has been fabricated and is being checked out. This will be used to monitor the progress of sample saturation prior to permeability measurements.

Evaluation of Additives.

Efforts are now underway to determine the availability and delivered price of pozzolonic fly ash to oil shale development sites in the Piceance Creek Basin. If favorable, fly ash will be tested as a grout additive.

Structural modeling of grouted retort.

Statistical fracture mechanics procedures are being applied to the overburden above the retorts to assess the most likely in-situ tensile strength. Laboratory tensile strengths from nearly 90 tests have been extracted from the literature and will be extrapolated to in-situ conditions. This procedure will permit more rational assessment of the factor of safety of the overburden with respect to tensile failure.

TASK 5. LEACHING OPTIONS

Batch leaching experiments directed toward the measurement of diffusion of total organic carbon (TOC) within the pores of the solid shale continued. In these experiments, a slab of spent shale is suspended in a container of stirred water and the time rate of change of TOC in the liquid measured. Results of the experiments are inconclusive at this time. TOC concentrations in the fluid exhibit considerable scatter and do not increase smoothly with time as expected. The experiment is being continued to examine the rate of change of TOC as the solid and fluid phases approach equilibrium, and to determine the reasons for the scatter of TOC concentrations with time.

TASK 6. GEOHYDROLOGIC MODIFICATION

Development of groundwater flow model

Investigation of dewatering scenarios for tract C-b by internal drainage is being continued. Table 1 summarizes additional cases evaluated this month.

Table 1. Summary of internal drainage dewatering scenarios evaluated in May.

Case	Layer	Unsaturated Properties	Saturated Permeability (m_2)	Specific Storage
E	Upper Aquifer	$S(\psi)_1$; $K(\psi)_2$	1.30×10^{-15}	—
	Lower Aquifer	—	1.28×10^{-14}	1.14×10^{-5}
F	Upper Aquifer	$S(\psi)_1$; $K(\psi)_3$	4.80×10^{-14}	—
	Lower Aquifer	—	1.28×10^{-14}	1.14×10^{-5}

The saturation-pressure head relation for $S(\psi)_1$ was presented in the April monthly report. Permeability-pressure head relations for $K(\psi)_2$ and $K(\psi)_3$ are shown in Figure 1. The flux for Cases E and F as well as previous cases (A, B, C, and D) is plotted for a two-year period in Figure 2. Case E is a clear illustration of the enormous effect of permeability of the upper aquifer on flux. Although the retorted region expands with time, increasing the area subject to drainage, low permeability of the upper aquifer impedes the flow with the result that the flux approaches a constant value after approximately 2 years. Case F illustrates the influence of the permeability-pressure head relation on flux. The difference between Case F and Case E is due to the difference in the permeability-pressure head relation, again showing the importance of this relation when unsaturated flow is considered.

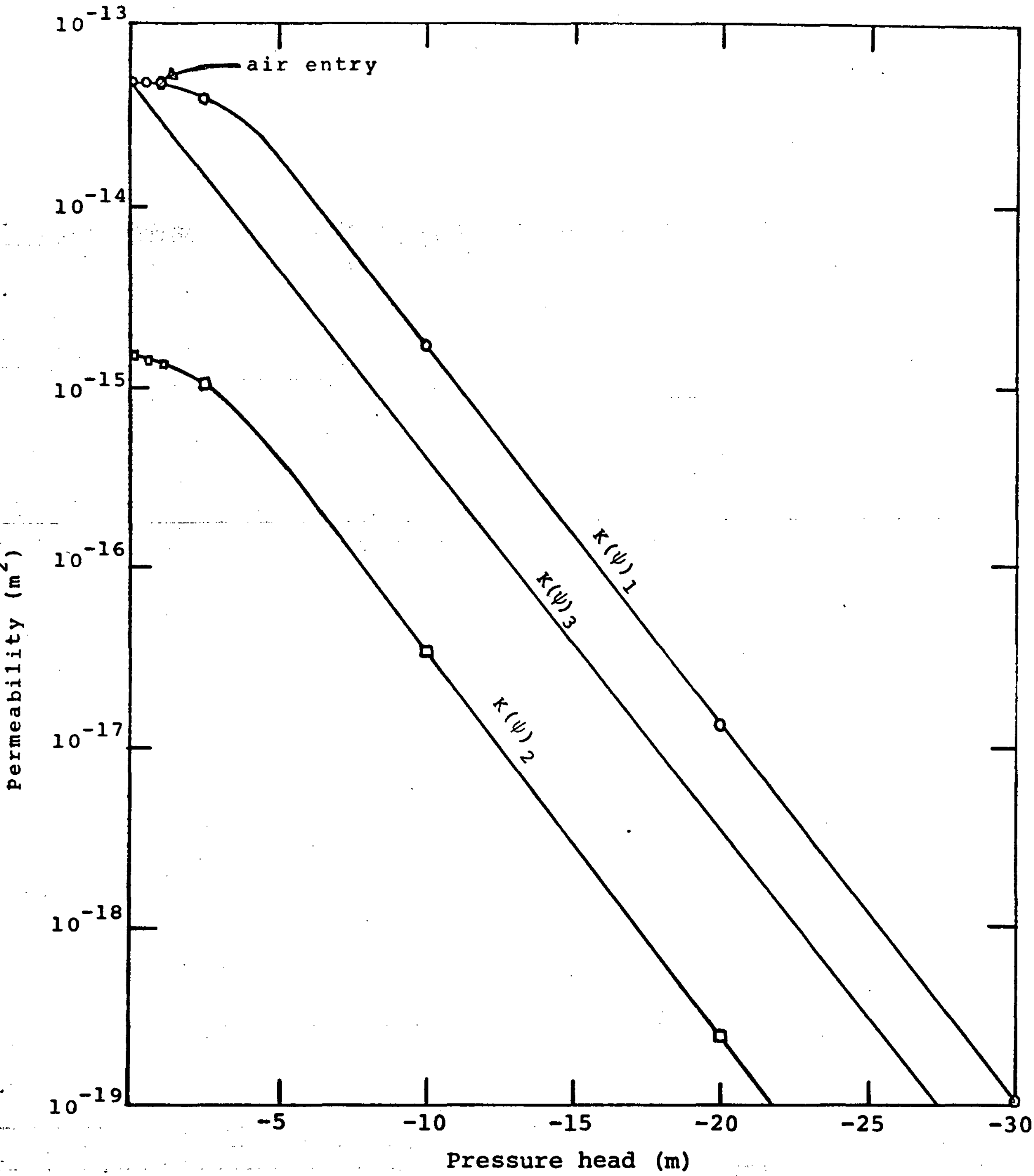


Figure 1. Two assumed relationships between permeability and pressure head for the Upper Aquifer, $K(\psi)_1$ and $K(\psi)_3$, and one for the Mahogany Zone, $K(\psi)_2$.

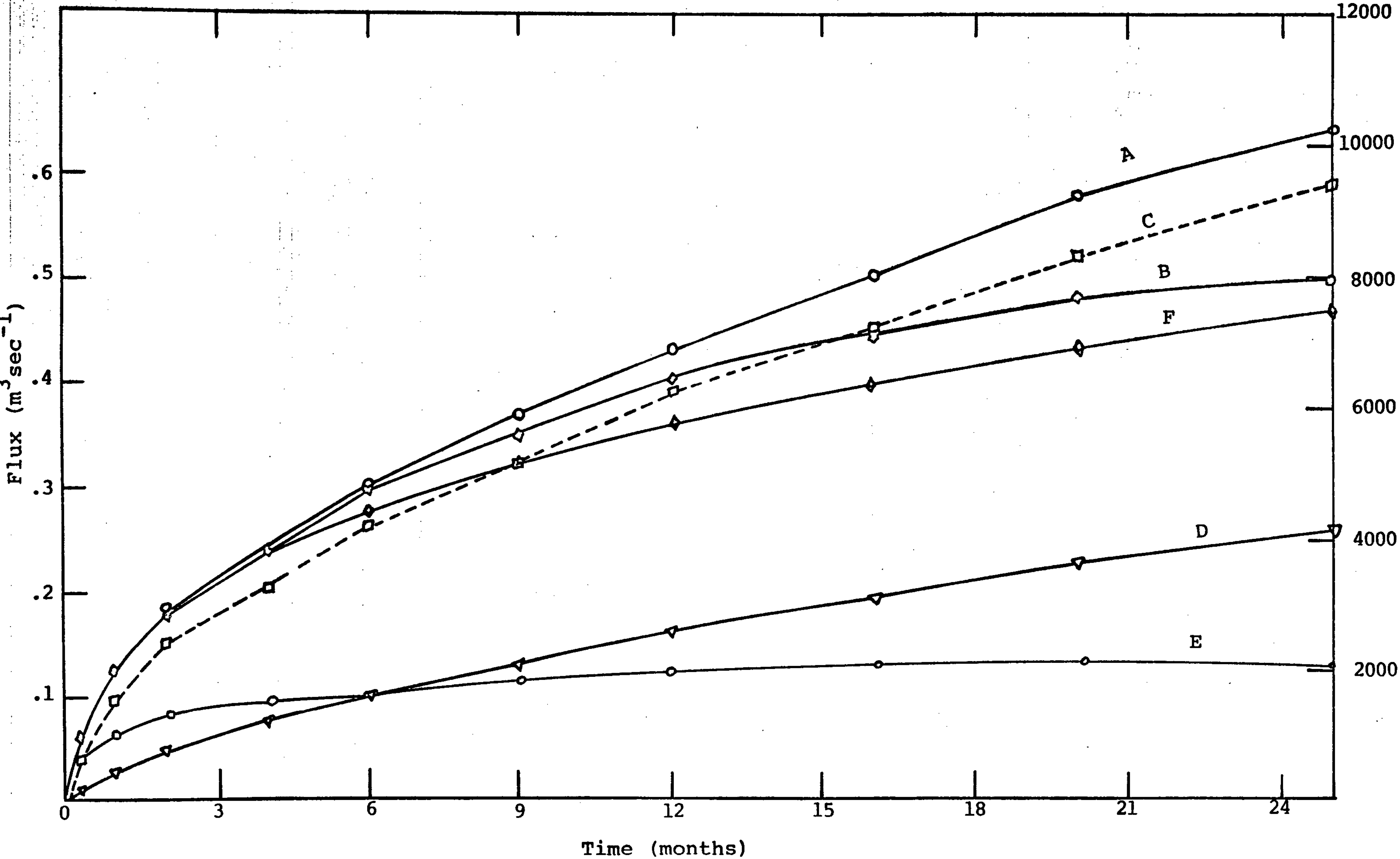
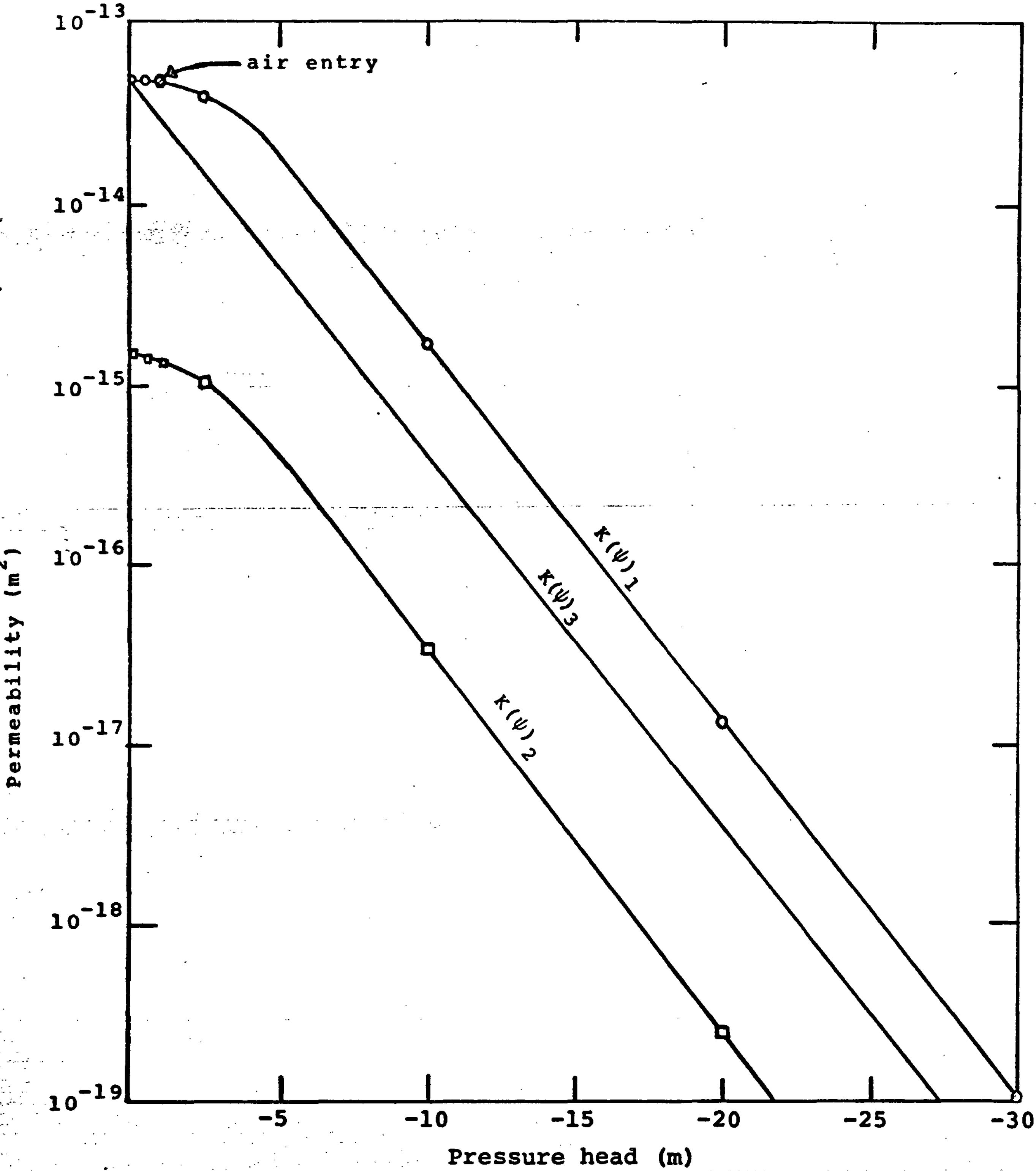


Figure 2. Rate of change in flux in mine drainage of an expanding retort in Tract C-b.



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TECHNICAL INFORMATION DEPARTMENT
LAWRENCE BERKELEY LABORATORY
UNIVERSITY OF CALIFORNIA
BERKELEY, CALIFORNIA 94720