Date: 1/29/96

To: Margaret Chu, Dept. 6801, MS-1325

From: Michael Lord, Dept. 6749, MS-1328

Subject: **Parameters describing the variable porosity and permeability within anhydrite material.**

I have considered ways of honoring the porosity/permeability response to pressure within the anhydrite marker beds as suggested in the enclosed memo from Kurt Larson of 1/24/96 and discussions with Palmer Vaughn. The following values typical of the performance assessment data were assigned:

pressure at fracture initiation	= 12.7 MPa
pressure at full fracture condition	= 16.5 MPa
porosity at reference condition	= 0.011 (1.1%)
permeability of intact anhydrite	= 2.5E-19 m^2
permeability at full fracture condition	= 1.0E-09 m^2

The porosity at full fracture condition was then adjusted in order to produce a change in porosity of about 1% at 2.5 MPa above fracture initiation pressure or a pressure of 15.2 MPa. This was obtained with a maximum porosity of 0.05(5%). In the attached Fig. 1 the resulting porosity response is shown. The corresponding permeability response is shown in Fig. 2. At 2.5 MPa above fracture initiation pressure, the permeability is between 3 and 4 orders of magnitude larger than the intact value. This would represent the desired response in marker beds 138 and 139. A similar analysis was done for marker bed a+b where the full fracture porosity was taken to be 0.25 (25%). For this value of maximum porosity the porosity at 2.5 MPa above fracture initiation pressure is approximately 3% above the porosity at fracture initiation pressure. This is shown in Fig 3 and the result is in line with the proposed response. Fig. 4 shows the permeability at 2.5 MPa above fracture initiation pressure as approximately 4 orders of magnitude above the intact permeability.

Based on this study I would recommend assigning the fracture parameters as follows. The fracture initiation pressure should be set as done in the FEPs calculations where it is assigned a value of 0.2 MPa above the grid block initial pressure. Therefore, there could be some small variance in the fracture initiation pressure if the reference initial pressure in the Salado is sampled. Also, there will be some small variance due to the dip in the Salado formation. However, the fracture initiation pressures should be near the 12.7 MPa value. The pressure at the full fracture condition should be an increment of 3.8 MPa above the fracture initiation pressure. This would result in a full fracture pressure of approximately 16.5 MPa. The full fracture permeability can be any large sampled or assigned value such as the 1.0E-09 m^2 used in this study. The full fracture porosity for the marker beds 138 and 139 will have value 0.05 and the full fracture

porosity for the marker bed a+b will have value 0.25. With these values the pressure dependent porosity and permeability should closely approximate the LEFM predicted values.

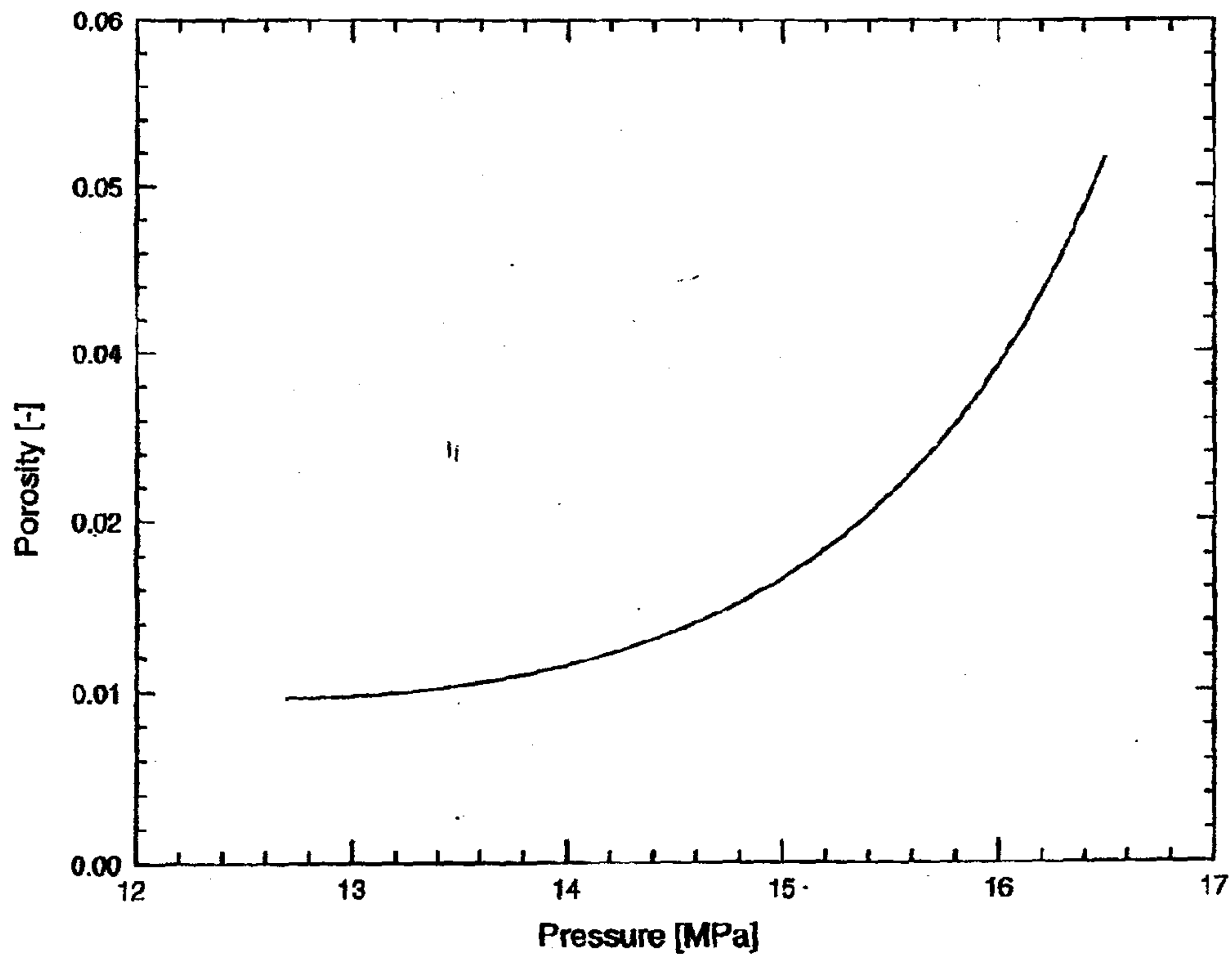

Figure 1: Porosity in Marker Bed 138 & 139 with Fracturing

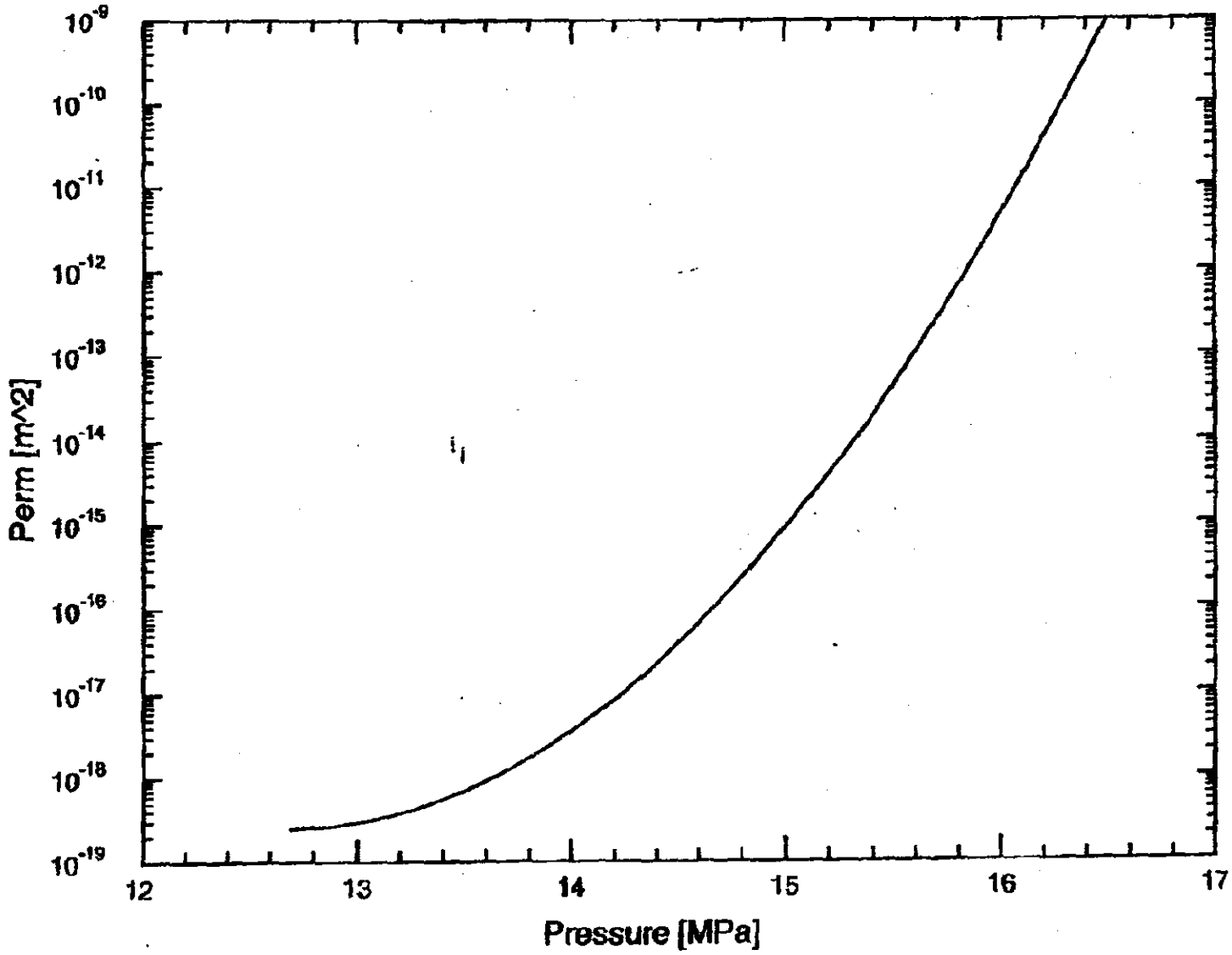

Figure 2: Permeability in Marker Bed 138 & 139 with Fracturing

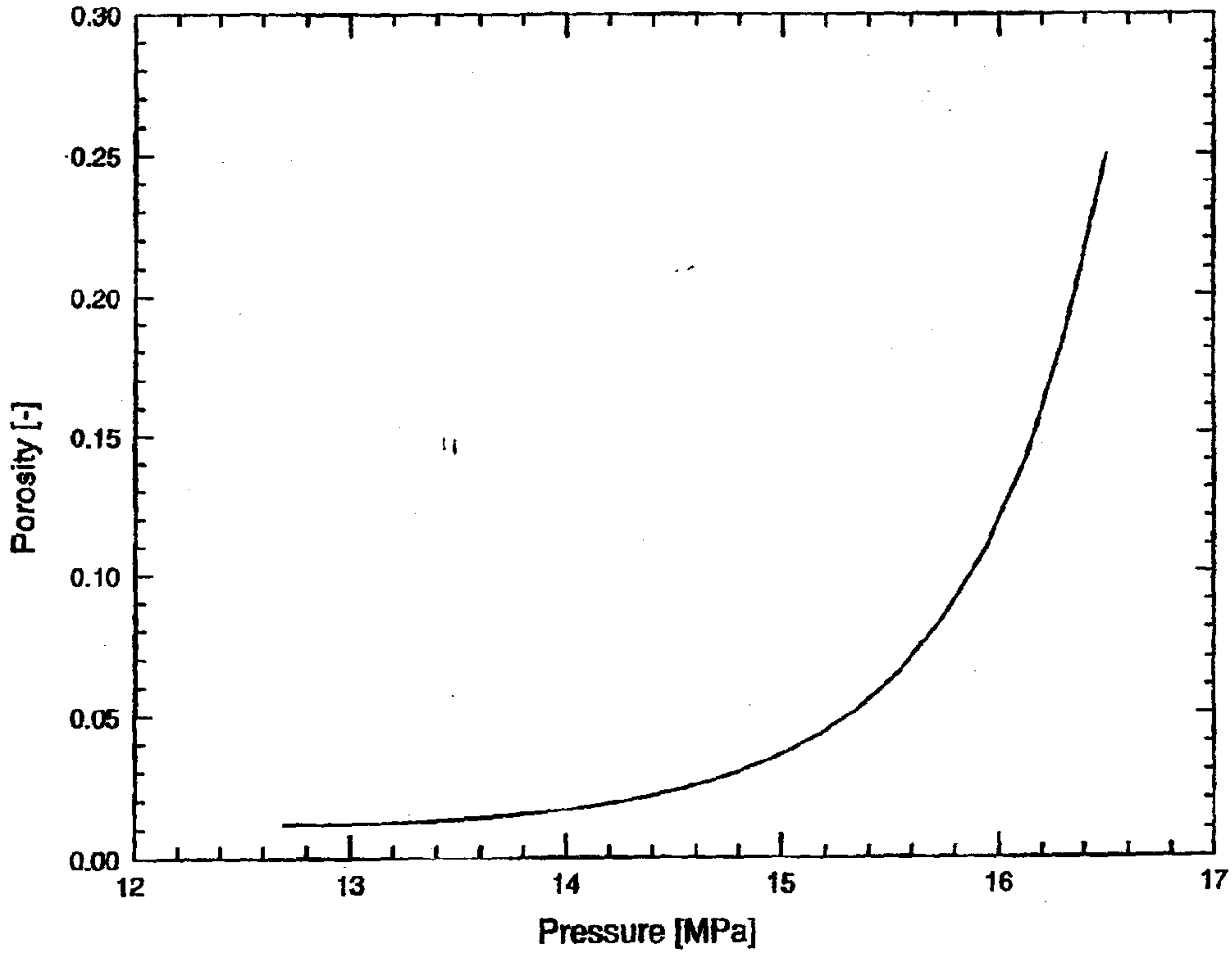

Figure 3: Porosity in Marker Bed A+B with Fracturing

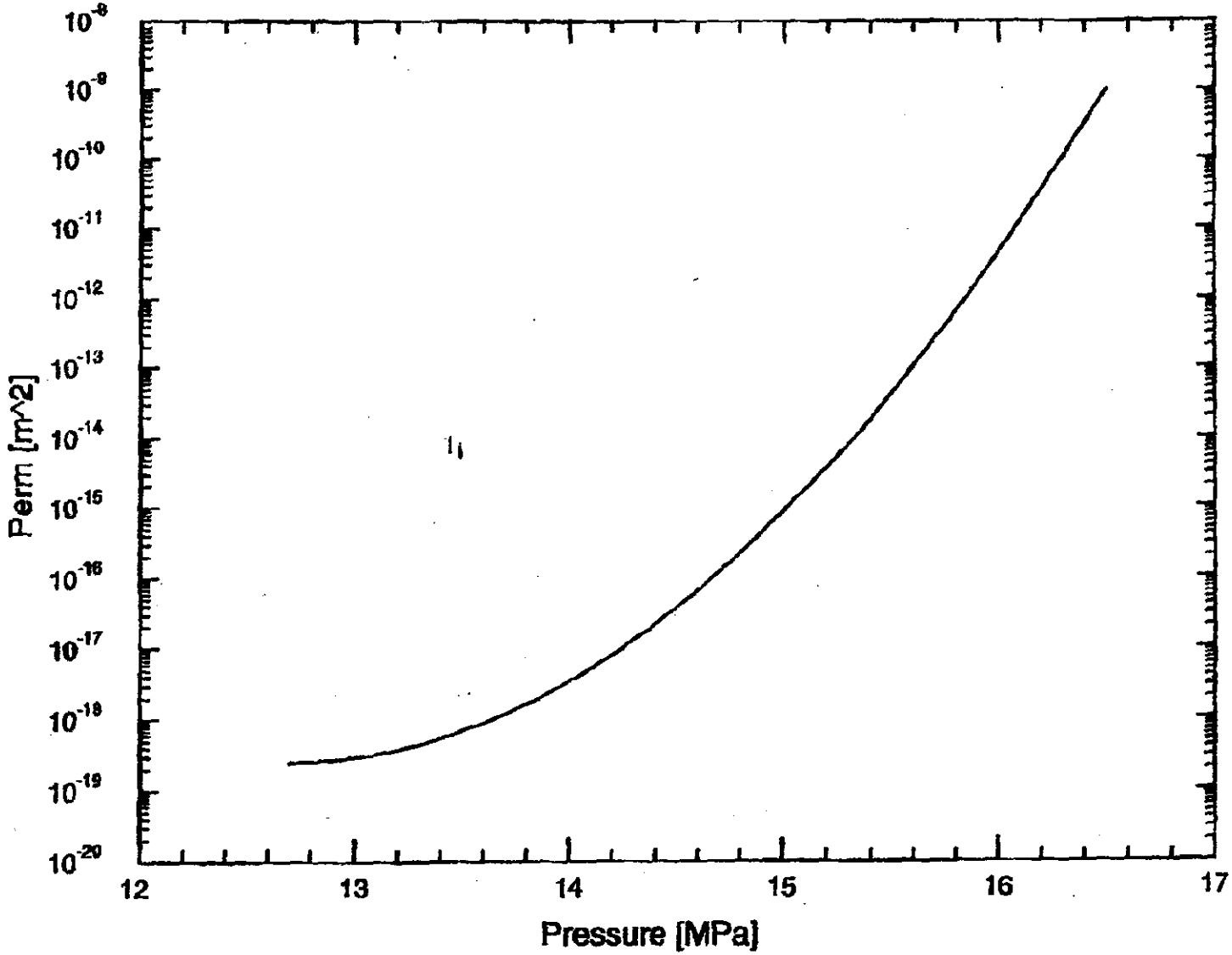

Figure 4: Permeability in Marker Bed A+B with Fracturing