the thermocouple circuit as divided up into small segments each with a particular ΔT across it. An emf will be induced across the segment which is proportional to ΔT. The proportionality constant is the thermoelectric power (α) of the material being used. The total thermal emf of the circuit is determined by summing all the emf's from each segment. Thus,

$$V = \Sigma\alpha_i \Delta T_i \rightarrow \oint \alpha(T)dT \tag{1}$$

Figure 1a is a schematic diagram of a typical thermocouple circuit used in a high-pressure environment. The circuit consists of two dissimilar wires which go from ambient pressure through pressure seals into the high-pressure and high temperature environment. The seal is represented by the crosshatched region, and in this region the pressure increases from the ambient pressure to the high interior pressure. For this analysis it is assumed that the sealing region is isothermal. The errors introduced when this assumption is not valid are discussed later.

The temperatures of significance in this circuit are the reference temperature T_0, the temperature of the seal region, T_1, and the junction temperature T_2.

The T.E.P. of a given material is in general a function of temperature and pressure and can be written as the sum of a pressure-independent term and a pressure-dependent term.

$$\alpha_a = \alpha_a(T) + \Delta\alpha_a(p,T) \tag{2}$$