8. Calculation of Zeta

The ambiguity of age calibration constants including (the spontaneous fission decay rate of 238), and the “B-value” encountered in thermal neutron dose measurements has been a controversial problem for a long time in fission track dating (FTD) (Bigazzi, 1981; Hurford and Green, 1981).

To circumvent the problem, an alternative way of system calibration, named the zeta calibration, was proposed, in which a calibration constant zeta is determined experimentally against a series of age standards that are well established (Fleischer and Hart, 1972; Hurford and Green, 1982, 1983). The first systematic attempt at calibration was carried out against four zircon standards by Hurford and Green (1983). For determining an unknown AFT age using age standard approach, first the $\delta$ value must be determined. According to Hurford (1900 a-b), a good $\delta$ value requires a calculation of five pairs of standard samples which are derived from five different irradiation cans. In this study, three samples from Durango were counted. The track density on the dosimeter glasses is related to the neutrons fluence. The magnitude of the neutron fluence depends upon the position of the samples during irradiation; the closer a sample is to the radiation source, the larger its track density is derived from a linear regression line of several track numbers of each dosimeter glass in one can.
Table 9.1: Fission track analytical data for zeta calibration and sample weighted mean zeta (SWMZ) value for age standard. Weighted Mean Value of Zeta \( \approx 250 \) Ma. Standard Age of Durango Apatite = 31.4\( \pm 0.5 \) Ma (McDowell and Keizer, 1977)

All of the standard samples were analyzed using the external detector method, with a geometry factor G=0.5, Ns and Ni are numbers of spontaneous and induced tracks respectively, \( \rho_s \) and \( \rho_i \) are the density of spontaneous and induced tracks per cm\(^2\), Nd is the amount of induced tracks on the mica, and \( \rho_d \) is the density of induced tracks on mica per cm\(^2\). \( P(\chi^2) \) – probability for obtaining \( \chi^2 \) value for n degrees of freedom, where n=no. of grain – 1.