Apparent Molar Volumes and Apparent Molar Heat Capacities of Aqueous Isoleucine and Threonine Species in Their Protonated Cationic, Zwitterionic, and Deprotonated Anionic Forms at T/K = (278.15 to 368.15) and at P = 0.35 MPa

S.P. Ziemer and E.M. Woolley[C, S]
Department of Chemistry and Biochemistry, Brigham Young University, Provo, UT, U.S.A.
earl_woolley@byu.edu

We have measured the densities of aqueous solutions of isoleucine, threonine, and of equimolal solutions of each amino acid separately with HCl and with NaOH at temperatures T = (278.15 to 368.15) K, at molalities m = (0.01 to 1.0) mol/kg, and at the pressure 0.35 MPa using a vibrating tube densimeter. We have also measured the heat capacities of these solutions at T = (278.15 to 393.15) K and at the same molalities and pressure using a twin fixed-cell differential temperature-scanning calorimeter. We used the densities to calculate apparent molar volumes and the heat capacities to calculate apparent molar heat capacities for each solution. We used our results and related data from the literature to calculate parameters for the molar heat capacity change for the two proton dissociations from protonated aqueous cationic isoleucine and threonine. We integrated these results using Young's Rule to account for the effects of speciation and chemical relaxation on our observed apparent molar volumes and apparent molar heat capacities. This procedure yielded parameters for apparent molar volume and apparent molar heat capacity for the aqueous isoleucinium and threoninium chlorides and the sodium salts of isoleucinate and threoninate. The results allow a complete description of the speciation in solutions of all of these solutes as functions of molality and temperature.