A Big Data Viscosity Model for Oxide Melts: A Preliminary Report

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Accurate calculation of viscosity for multicomponent systems is highly meaningful in fields of material, metallurgy, geology, energy, etc. Over the last several years, a viscosity database for oxide melts (including slags, glasses, magmas, and non-silicate melts) was established in authors' lab through collecting open published viscosity measurements from thousands of studies date back to 1940s. It currently covers more than 30 components and 60,000 viscosity measurements, and becomes one of the largest viscosity databases in the world. Based on this database, a big data viscosity model was constructed, which expresses the temperature dependence by the MYEGA equation, and the composition dependence by pair-wise interactions between each component. The preliminary model covers 23 components, including SiO2, Al2O3, CaO, MgO, FeO, Fe2O3, K2O, Na2O, Li2O, B2O3, P2O5, TiO2, ZrO2, CrOx, SrO, BaO, MnO, CuO, PbO, ZnO, NiO, H2O and F. The model was calibrated by more than 43,000 viscosity measurements, which cover over 17 log units of viscosity (from 10^{-2} to 10^{15} Pa·s). The adjustable parameters in the model were obtained in a global way by the Quasi-Newton method. It was found the model-calculated viscosities agree very well with the measured values, with an overall relative error (difference between measured and calculated value) as low as 0.145 log unit. The model is very accurate and easy to understand, thus it can be used conveniently in research and development activities in related fields, or embedded in numerical simulations as a part of the program. The model will be optimized further to incorporate more components and improve the calculation accuracy and reliability.