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THE ORDERED STRUCTURE OF A BASALTIC MELT WELL ABOVE THE LQUIDUS TEMPERATURE - A CALORIMETRIC STUDY

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Workability and spinnability of a glass melt strongly depend on its fragility. Poor spinnability is associated with high fragility. The latter is reflected by a high sensitivity of the melt viscosity to temperature (T) and by a strong tendency to crystallise. Both features affect the glass forming and fibre spinning processes and the mechanical properties of the final products. The emphasis of this work is placed on the study of the crystallisation behaviour of a basaltic glass (a relative fragile system). Calorimetric experiments are performed to find out whether the structure of a melt above the liquidus temperature (T_m) is always a disordered one or not. The strategy of this study is to repeatedly up- and downscan the sample at a rate of 20 K/min in a differential scanning calorimeter between 333 and 1523 K. The glass is kept at 1523 K (= T_m + 70 K) for a certain period of time to ensure a complete melting of the crystalline phase. By doing so, an interesting phenomenon is observed regarding thermal responses of the melt. By repeating up- and downscans, the single exothermic peak on the downscan curve is gradually separated into two and then three peaks, and subsequently the peak at the highest temperature becomes increasingly dominant. The width of the peaks decreases, while the height of the peak increases. Finally, only a single sharp and narrow peak at high temperature exists due to the formation of a uniform and single crystalline phase, i.e. plagioclase phase. A gradual transformation from a poly- to a mono-crystalline phase occurs during downscans. This indicates that the ordering degree of the melt structure at $T > T_m$ increases when the up- and downscans are repeated. This also suggests that the melt favours the structure of the stable crystalline phase, i.e. plagioclase. The mechanisms of the crystal-crystal transformation phenomenon are discussed in detail.