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Volcanic eruptions and physics of lavas (Robert Wilhelm Bunsen Medal Lecture)

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Ever since the early days of volcanology, it has been recognised that volcanic activity is determined by the physical properties of magmas. For instance, fluid lavas generally erupt rather quietly and flow over possibly long distances, whereas viscous lavas build up domes or even give rise to strongly explosive manifestations. Likewise, the fundamental role of water exsolution as the driving force of volcanic eruptions has been known for more than two centuries.

Going from such qualitative statements to quantitative investigations of the main factors at play has long proved difficult, however. It is only in the last decades that experimental and conceptual advances have allowed detailed investigations of the physical properties of magmas to be made as a function of chemical composition, temperature and even pressure. Although experiments on volatile-bearing liquids are intrinsically difficult, important progress has also been made for a wide range of hydrous silicate melts. Some of these advances will thus be reviewed in this talk for the viscosity, density and thermodynamic properties of melts in the light of volcanic activity.