Early thermal evolution model of planetesimals considering silicate-metal separation

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The solar system is believed to have formed from a cloud ofhot gas and dust known as the Solar Nebula, whose compositionis expected to be similar to the present-day Sun"s composition.As the cloud cooled, dusts settled into a thin dust layer atthe midplane. When the layer of sedimented particles becamesufficiently dense, the gravitational instability was triggeredand the layer crumbled into numerous kilometer-sized bodies,the so-called ``planetesimals"". Accretional collision ofplanetesimals formed lunar to Mars-sized protoplanet withinabout one million years. Around the orbit of present Earth(orbital radius = 1AU), several tens of protoplanets formed.Once runaway formation of protoplanet had terminated due tolack of planetesimals, protoplanets collided with each otherto form larger objects. In terms of evolution of planet, differentiation is one ofthe most important events. Particularly, mantle-corediffferentiation should affect not only the internal structureof the planet but also the following evolution of the planet,by heating the interior of the planet by released gravitationalenergy and/or by changing the effect of impact-heating. Although when and how the central metallic core formed isstill an open question until now. Recently,Yoshino et al. (2003) showed that molten metal can permeatethrough solid silicate under high temperature and pressurecondition if metal contains sulfur to some degree. Thereforewe are developing a new numerical model to simulate earlyevolution of asteroid taking accretion and core formationdue to permeable flow into account.According to our results, central metallic core can form ifsintering of silicate grains is neglected, however, for thecase that sintering effect is taken into account metalliccore cannot form until the solidus temperature is achieved.Generally sintering of silicate grains proceeds at lowertemperature than the melting temperature of metal.Our results suggest that within a small planet, such asplanetesimal and parent body of meteorites, metallic corecannot form by permeable flow.