Honey material properties

Both the viscosity and the density of honey change with temperature and water content (figure1).

Figure 1. Data showing the variation in the viscosity of different samples of honey with moisture content. From the data of Lazaridou (2003).

Because the properties of honey are quite variable, we decided that it was important to characterize some of the properties of our honey. Our measurements of the density of our honey were unusually high which means that the honey had a low water content and a high viscosity (figure 2).

Figure 2. Measurements of density change with temperature.

While running experiments we noticed that the heat from a lamp we were using as our light source was causing a significant effect on the viscosity of the honey and on the behavior of our subducting slab (see movie 3). To find the change in viscosity needed to cause this effect, we measured the viscosity of our honey at various temperatures. To measure viscosity, we measured the amount of time it took BBs to fall through a tube of honey at various temperatures (Figure 3).

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Figure 3. Using a tube with a diameter of 6.08 cm, we measured the amount of time it took BB's to fall 20 cm through the honey at varying temperatures. It was necessary that the tube be significantly longer than 20 cm so that the BBs would reach terminal velocity before we started measuring and so that the BBs did not slow down while we were measuring them from interactions with the bottom of our cylinder.

At each temperature we timed 3-5 BBs of known mass and diameter. We used the equations from Steffe (1996)

and

where is the viscosity, is the density of the BB, is the density of the honey, R is the radius of the BB, g is the acceleration due to gravity, t is the time it took the BB to fall a distance L, L is the distance the BB fell, a factor which correct for the effect of the walls of the tube and is the ratio of the tube diameter to the BB diameter, and is the viscosity after correcting for the effects of the cylinder walls. Our results follow the expected power law relationship well (Figure 4).

Figure 4. We compared our viscosity measurements with those of Steffe (1996). Both experiments follow the expected power law relationship.