Reagents, Compositions, Weight Loss
Notes for Instructor

Why?

Students in Mineralogy do a number of different experiments. This activity is to get them started. In part it is a review of formulas, atomic weights, moles and grams, and converting weights and percents, etc. More importantly, it is an introduction to doing lab experiments where care is required.

Poor Lab Skills

As a group, mineralogy students have very poor lab skills. A fundamental key to this exercise is to have a number of different groups doing it independently and to make them compare results and explain discrepancies. They will make many basic mistakes. Instructors and TAs must keep harping on the need for care, cleanliness and good lab notes.

Having them do things independently, and then having to justify results to their peers, is excellent training and helps develop the skills necessary to go on to bigger and better things.

Let me emphasize: It is imperative that you have replicate experiments so you can compare results. Otherwise you will not know what the "correct" answers are!

Reagents

You can use any reagents for this project. We use some of those that we will use later in the semester for making synthetic minerals:

- aluminum hydroxide
- silicic acid
- magnesium oxide
- calcium carbonate

It is important to remember that labels on reagent bottles do not tell the whole story. Aluminum hydroxide, for example, can have different amounts of H_2O in it depending on its source. Silicic acid has many different varieties. Furthermore, all reagents have the capacity to absorb water; sometimes quite a lot of water. So, the experiments are truly experiments.

Weighing

Weighing errors are by far the biggest source of problems. So, in our lab, the rule is that everything that gets weighed on our scales gets written down in a "scale" book. And, everything must be weighed by two different people. They write the weight in the book and initial it. Many times, we find students going back to that book because their lab notebooks contain erroneous or missing information.

Predictions

We tell the students that they must predict experimental results before doing the

experiments. They don't like to do this. But, make them. It is important that they learn to analyze – to do thought experiments – and then later to explain if they get inconsistent results.

Reports

Just as many student have poor lab skills, some have poor writing skills. So, we work hard with them to see that they produce good lab reports.

Used Later

The products of this experiment are used later when the students are introduced to X-ray diffraction. They use the diffraction results to further interpret the results of these experiments.

Answers

This project is an experimental project and there are no correct answers for most of it.

A. Experiments at 110°

For each reagent:

1. Determine its formula
2. Calculate the mole % of each element in the reagent
3. Calculate the weight % of each element in the reagent
4. Calculate the mole % of each oxide in the reagent
5. Calculate the weight % of each oxide in the reagent

Reagents vary, so read the label on the jars carefully, and then don't be surprised if there seem to be some inconsistencies. Silicic acid may have any of a number of compositions, and so too the aluminum hydroxide.

Ideal Element Weight %s, for the reagents we have in our lab:

	Al	*O*	*H*	*Si*	*Mg*	*Ca*	*C*
Al hydrox	*34.59*	*61.53*	*3.88*	*0.00*	*0.00*	*0.00*	*0.00*
silicic acid	*0.00*	*61.46*	*2.58*	*35.96*	*0.00*	*0.00*	*0.00*
MgO	*0.00*	*39.70*	*0.00*	*0.00*	*60.30*	*0.00*	*0.00*
$CaCO_3$	*0.00*	*47.96*	*0.00*	*0.00*	*0.00*	*40.04*	*12.00*

Ideal Oxide Weight %s for the reagents we have in our lab:

	Al_2O_3	*H_2O*	*SiO_2*	*MgO*	*CaO*	*CO_2*
Al hydrox	*65.36*	*34.64*	*0.00*	*0.00*	*0.00*	*0.00*
silicic acid	*0.00*	*23.07*	*76.93*	*0.00*	*0.00*	*0.00*
MgO	*0.00*	*0.00*	*0.00*	*100.00*	*0.00*	*0.00*
$CaCO_3$	*0.00*	*0.00*	*0.00*	*0.00*	*56.03*	*43.97*

The Results:

After heating to 110°, the reagents should all show some weight loss. Results depend on the reagents used and so will vary from lab to lab. Mostly, there should be only a minor amount of weight loss as absorbed water is driven off. In my experience, MgO and $CaCO_3$ tend to lose the most weight. Depending on they were stored and the relative humidity, the loss can be 3-10%.

B. Experiments at 1200°

The results:

As before, results may vary depending on many things. Ideally, Al hydroxides loses water to become Al_2O_3. Silicic acid loses water to become SiO_2, MgO doesn't change much, and $CaCO_3$ loses CO_2 to become CaO.

So, ideal weight loses will be:

	ideal weight loss
Al hydrox	*34.64*
silicic acid	*23.07*
MgO	*0*
$CaCO_3$	*43.97*

If the reagents are not weighed quite quickly after being removed from the ovenn, they will regain some weight. Especially the CaO; it can absorb lots of water very quickly.