**Transcript of MCS v.2019 AFC Run MES Input File YouTube Video**

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In this video, I’m going to walk you through how to prepare an input file for an assimilation and fractional crystallization run using the Magma Chamber Simulator. So the first thing we need to do is open up the input file. In order to get to that, we need to navigate to our Finder Window – again, if you’re not quite familiar with a Mac, it’s down here in the bar, and it’s a little happy face. From there, we can navigate to our Documents folder, and then into our MCS folder, and then into our “Input & Output” folder. Again, if you’re making your own input file from scratch, you can use this general “Prototype MES” file in this folder to type over. But for right now, we’re going to open up our pre-populated AFC file, called “MES\_AFC\_1”.

**0:58**

Just as a reminder, the first part of the MES file we’ll need to complete is the blue box where we set our global system variables – these are variables that apply to all three subsystems. In previous MES Input File tutorials where we’ve not done assimilation, we’ve set our fmZero at 1. But, because we do want to assimilate some of the wallrock in this model, we’re going to set this value somewhere between 0 and 1. Just as a reminder, fmZero represents the minimum mass fraction of liquid that must accumulate in the wallrock subsystem in order to trigger assimilation. For example, let’s set our fmZero at 0.05 (or 5%). During the run, heat from the magma subsystem is transferred to the wallrock subsystem, partially melting it. So, when fmZero is set at 0.05, if greater than 5% liquid accumulates in the wallrock subsystem at any point during the run (such as, say, if we were to 6.4 % liquid, for example), that percent liquid, less 5%, is transferred to the magma subsystem. So in this case, 1.4% of the liquid accumulated in the wallrock subsystem at that particular equilibration step will be transferred to the magma subsystem, and then the new, equilibrated magma composition will be calculated. And this will happen every time the percent liquid accumulates in your wallrock, and that percent liquid gets over that fmZero threshold.

**2:37**

The next global system parameter is the Excluded Phases category. I’m not going to exclude any phases in this tutorial, but if you’re not sure how to do that and you need to, you can refer to our prior tutorial on how to complete an MES Input File for an FC-only run. Our next global system parameter is pressure - again it’s given in bars - so, we want to run this model at 2 kilobars, so we’ll enter 2000 into this cell. Let’s leave Enthalpy Convergence Steps alone – remember, the sweet spot for this variable is 30, so we’ll leave 30 in this box unless you find yourself with some unreasonably good reason to. For our final global system variable, oxygen fugacity, we don’t want to run along a buffer during this simulation. So we need to type in “none” – remember, exactly as given in Column F – into this cell.

**3:39**

For our Magma subsystem, we’ve pre-populated this MES file with a basaltic composition, renormalized to 100 wt.%. So let’s set our Magma subsystem starting temperature, which is below our composition, and let’s set that at 1300 degrees. Remember, this is just a jumping-off point for MELTS to find the liquidus temperature for the Magma composition, so it doesn’t need to be particularly above or below the liquidus temperature, just somewhere in the general vicinity of that number. We’re also going to lower our deltaT down from the FC-only tutorial; now each equilibration step will occur every time the Magma subsystem has cooled 5 degrees. I wouldn’t really advise going any lower than that – the lowest I’ve been able to run without an issue is a deltaT of 2 degrees, but the MCS was really sluggish and unhappy due to the intensive nature of the calculations required.

**4:37**

Finally, we have our two different options for stopping the Magma Chamber Simulator runs prematurely – either at a Hard Stop Temperature, or at a certain percentage of liquid left in the Magma subsystem. In the previous MES Input file tutorial, we did an FC-only run, and used the Wallrock-Bypass option to avoid the Wallrock Find Solidus step (and this was done in order to save time, and also because if you’re not in need of that information, it really just is an extra step to do). But, because the Wallrock-Bypass Option wanted a Hard Stop Temperature, our run was terminated prematurely after the Magma subsystem had cooled to a temperature less than what we had set, which was 900 degrees. In this case, however, we are attempting to assimilate material, and we might be interested in what is happening at those lower temperatures, so we’re not going to employ any sort of Hard Stop function. Remember, when you elect to not use a Hard Stop, the MCS run will terminate when one of two things happens: either (1) MELTS will crash, or (2) the run will terminate once the Magma and Wallrock subsystems have reached thermal equilibrium.

**5:47**

Now for our Wallrock composition, we have this really nice Sierra Nevada Granite – and again, it’s had some water (just a smidge) and CO2 added to it, and that composition has been renormalized to 100 wt.%. As a reminder, because there is CO2 in this composition, I’m going to want to run this model using rhyolite-MELTS version 1.2.0, as that’s the one that can model CO2 as an exsolved volatile phase. The next few parameters for the Wallrock Subsystem are used during that Wallrock Find Solidus step. During this step, the MCS needs to calculate the phase equilibria constraints for the Wallrock composition prior to the run so it knows the *P-T-X* conditions at the value assigned for fmZero. So any time that you need information about the Wallrock subsystem, or if you are accounting for the wallrock in your run, or if you are considering the effects of assimilation (as we are here), you will need to complete the Wallrock portion of the MES Input File, and you will need to use the “Step 3: Wallrock Find Solidus” button during the MCS run, as I’ll show you in the next tutorial.

**7:00**

The first of these variables we need to assign is the Wallrock Find Solidus End Temperature. This is the temperature that the Wallrock Find Solidus step will stop at, and it needs to be at least one temperature decrement below the calculated solidus temperature for that composition. So, for example, if your deltaT is 20 degrees, this temperature needs to be at least 20 degrees below the calculated solidus temperature. This is a huge part of why we really advocate running your compositions through standalone MELTS at your proposed *P-T-X*-*f*O2 conditions – otherwise, you might be fixing this value over and over and over again, until you get it just right, instead of spending an extra five minutes from the get-go and not having to redo your run parameters twenty-seven times. So here, we’re gonna actually set this end temperature at 730 degrees, so I know that’s *below* where fmZero is, and that’s below where the solidus is.

**8:02**

The next parameter is the deltaT for the Wallrock Find Solidus step. This is essentially the same parameter as for the Magma subsystem, but this time it is in degrees C in between each equilibration step during the Wallrock Prime portion of the run. Because your deltaT kind of controls how fast your run progresses, I like to set my deltaT for this step around 25 degrees (but if you need fine-detail information, certainly feel free to set smaller deltaT values). In fact, this really is the case for this wallrock composition – I know that the fmZero lies… uh, within one deltaT of the solidus, if deltaT is set at 25 degrees. So I need my deltaT to be smaller, so there will be at least one deltaT between fmZero and the solidus. So I’m gonna set this, actually… I’m gonna go ahead and put this at 10.

**9:05**

Uh, the next parameter we will need to set for this step is the Wallrock Find Solidus Start Temperature, or the starting temperature just for this little prime segment of the run. Unlike the Magma starting temperature, this is not a jumping-off point for MELTS to find the liquidus T – the Wallrock Find Solidus Step will start at this value, and I would recommend setting it somewhere between the temperature for fmZero and the calculated liquidus temperature for this composition, as this step is really concerned with finding out the conditions surrounding whatever the value is you’ve set for fmZero. So let’s set ours to 850 degrees – I know that’s pretty low, but it’s gonna save us some time than if we were to start around the liquidus at, say, 1100 degrees.

**9:51**

The next parameter is the initial mass of Wallrock that you want in your system. In the Magma Chamber Simulator, the Magma subsystem automatically starts out at 100 grams, all of the time, and there’s nothing you can do to change it. So, if you are needing a certain wallrock to magma ratio, keep in mind that you will need to scale the mass of your wallrock proportionally to the Magma subsystem. Additionally, the heat used to melt the wallrock comes from crystallization in the Magma subsystem, so the smaller the mass of your wallrock is, or the more evolved your wallrock composition is, the easier it will be to generate some amount of partial melt over the assigned fmZero value, therefore triggering assimilation. For this run, we want a 1:1 ratio of Magma to Wallrock, so let’s assign a mass of 100 grams to the Wallrock subsystem.

**10:41**

The final parameter for the Wallrock subsystem is the initial temperature of the Wallrock at the beginning of the MCS run. Now, this is very different from the Wallrock Find Solidus Temperature – this is the actual temperature the Wallrock subsystem will be at at the beginning of your MCS run, and then it will heat up from there. So the only requirement for this parameter is that it must be lower than the Wallrock Find Solidus End Temperature, so essentially, the wallrock must be completely solid before the MCS calculations begin. This means you can’t start with your wallrock being a crystalline mush – sorry, guys. So let’s go ahead and set your wallrock temperature here to 400 degrees. And let’s save our input file.

**11:29**

Now in this simulation, because we’re not modeling any recharge events – only assimilation and fractional crystallization – the final thing for me to do is to make sure that recharge is turned off. The Magma Chamber Simulator can model up to five recharge and mixing events in one simulation, so you’ll notice that, you know, as you scroll down here in the MES file, you’ll see that each recharge event has a different color. The best way to turn recharge off is to make sure that the masses are set at 0, and that these two bottom boxes are empty. So I just like to kind of scroll through, make sure that the mass for each recharge is set at 0, there’s no trigger or deltaT trigger temperature set… and that’s all good.

**12:21**

So that concludes our tutorial on how to prepare an input file for an assimilation and fractional crystallization run using the Magma Chamber Simulator. In our next tutorial, I’ll show you how to prepare an MES Input file for a model involving recharge and magma mixing.

**12:36**