Thermal Modeling of Possible Surface Water Ice Deposits in Juventae Chasma. S. E. Wood[1], C. B. Leovy[1], D. C. Catling[1], D. R. Montgomery[2], E. A. Ginder[1]. [1]Dept. of Atmospheric Sciences, [2]Dept. of Earth and Space Sciences, Univ. of Washington, Seattle WA 98195, Email: sewood@atmos.washington.edu.

As described in the companion abstract of Leovy et al. [1], light-toned interior layer deposits (ILD) on the floor of Juventae Chasma and in other chasms and chaotic terrain in the martian tropics exhibit morphology and thermal inertias similar to that of the north polar layered deposits (Table 1).

To derive estimates for the thermal inertia and albedo of the various surface materials in Juventae Chasma listed in Table 2, we used a one-dimensional diurnal and seasonal thermal model to match the observed THEMIS brightness temperatures at 3 pm and 3 am. This model has been used in many previous studies of planetary surface energy balance and thermal stability of water ice deposits on Mars, Mercury, and the Moon [2,3,4]. Radiative and conductive heat balance is maintained at the surface, and the heat conduction equation is solved numerically for each of the 40 subsurface layers of increasing thickness extending to several times the annual thermal skin depth. Radiative heating of the surface by atmospheric thermal emission was parameterized as 2% of the local noontime insolation. For this study, each subsurface layer had identical thermophysical properties which remained constant for each model run. The model accounts for the effects of slope and orientation on direct insolation rates, and we obtained estimates of these angles (± 5°) for our study areas from the 128 pixel/degree MOLA topographic data.

Because the 3pm and 3am temperatures are close to the diurnal maximum and minimum, we were able to quickly converge on the unique combination of thermal inertia and albedo which produced the observed values – varying the thermal inertia to match the amplitude, then adjusting the albedo to shift the values up or down. The precision of our fits was limited by the variability of THEMIS brightness temperatures within each study area, typically ±1 K. Looking at the sensitivities of our model-calculated surface temperatures, we found that a 1 K change could be produced by varying the albedo by 0.01 or the thermal inertia by ~20 $Jm^{-2}s^{-1/2} K^{-1}$.

Table 1: Characteristics of Martian Surface Materials (from Viking IRTM and MGS TES observations)

Material	Albedo	Thermal Inertia $Jm^{-2}s^{-1/2}K^{-1}$
North polar layered deposits	.20 - .40	565
Center of North polar cap	0.48	1150
Solid ice (220 K)	-	2045
Earth sandstone	-	2344
Mars rock	-	1260
“White Rock” - Pollack crater	0.23	232 ± 14
Dust (5 µm)	0.25	40
Silt (50 µm)	-	125
Fine sand (200 µm)	-	230
Coarse sand (700 µm)	-	375

References: [1] Leovy, C. et al. (2004), (*this conference*). [2] Wood, S. E. and Paige, D. A. (1992), Icarus 99, 1-14. [3] Paige et al. (1994), JGR 99, 25959. [4] Vasavada et al. (1999), Icarus 141, 179-193.

Table 2: Derived Properties of Juventae Chasma Surface Materials

Juventae Chasma Features	THEMIS Brightness Temperatures (±1K)		Model Parameters		
	3 am $L_s = 351$	3 pm $L_s = 357$	Assumed Slope	Best-fit Albedo	Best-fit Thermal Inertia
Warmer layers on NW side of ILD-B	200 K	268 K	15° 25° 35°	0.20 0.19 0.16	480 500 520
Cooler layers on NW side of ILD-B	195 K	263 K	15° 25° 35°	0.27 0.26 0.24	420 440 460
Surrounding plateau	180 K	261 K	flat	0.31	240

Floor material	190 K	261 K	flat	0.22	400