


# Temperatures of Marco Polo Mission targets



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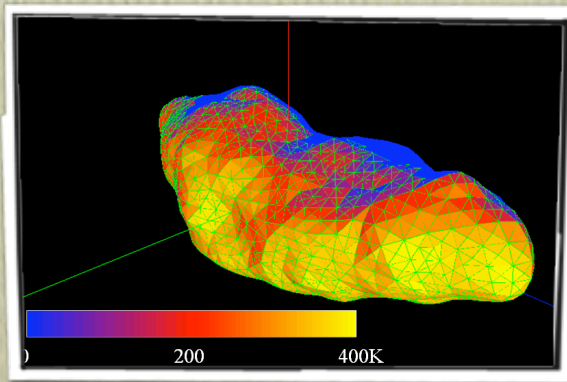
# Science/technical case

- Return of a sample of unaltered material from primitive asteroid.
- Several process alter material on asteroids: space weathering, gardening...
- What about heating (from the Sun) ?
  - Sample temperature  $< 40^{\circ}\text{C}$  (313K) -  $80^{\circ}\text{C}$  (353 K)  
(Koschny - yellow book)
  - Macromolecules found in meteorites are thought not to be stable at temperature  $> \sim 373 - 423 \text{ K}$

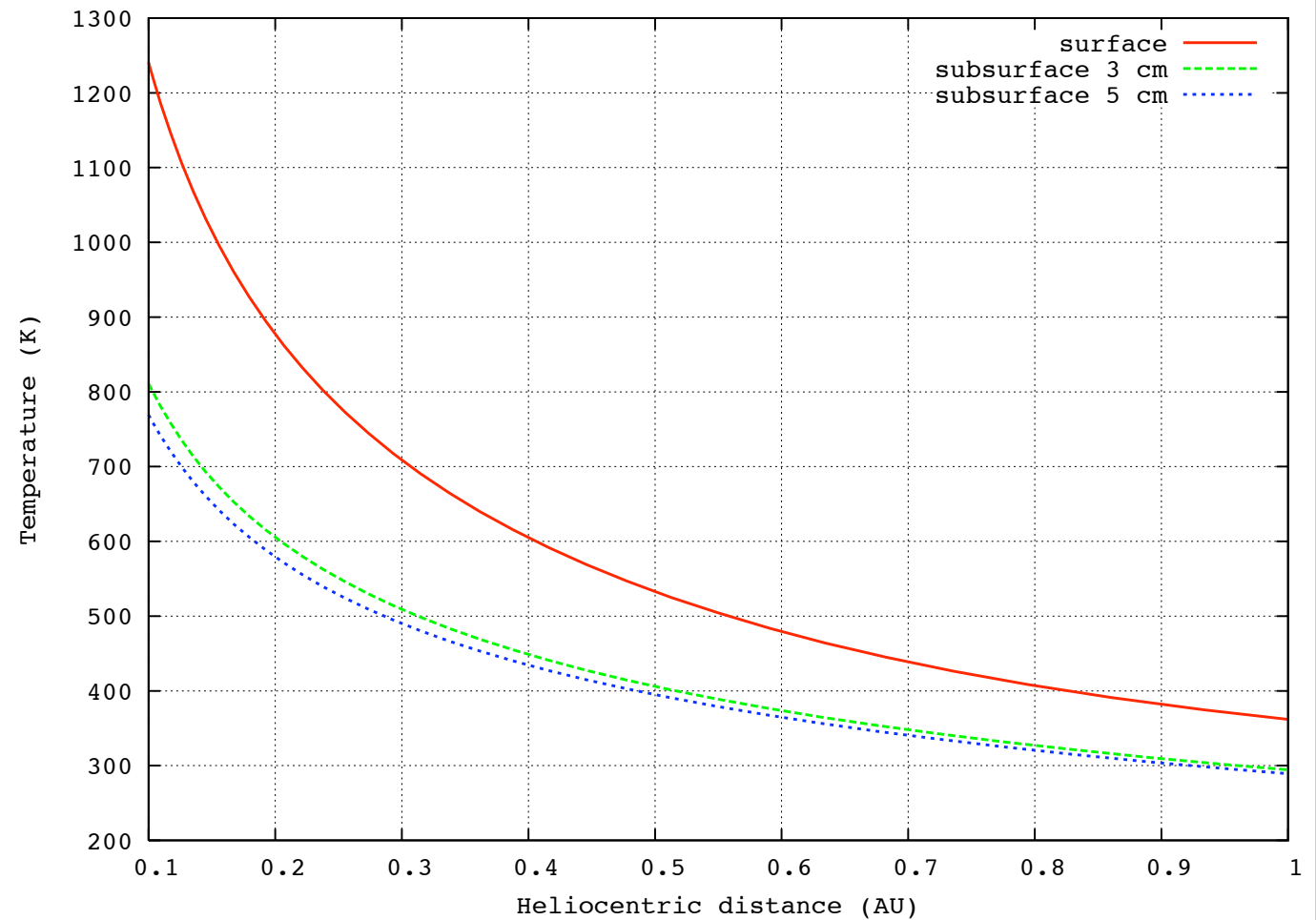


# Temperatures vs heliocentric distance

Thermophysical  
model

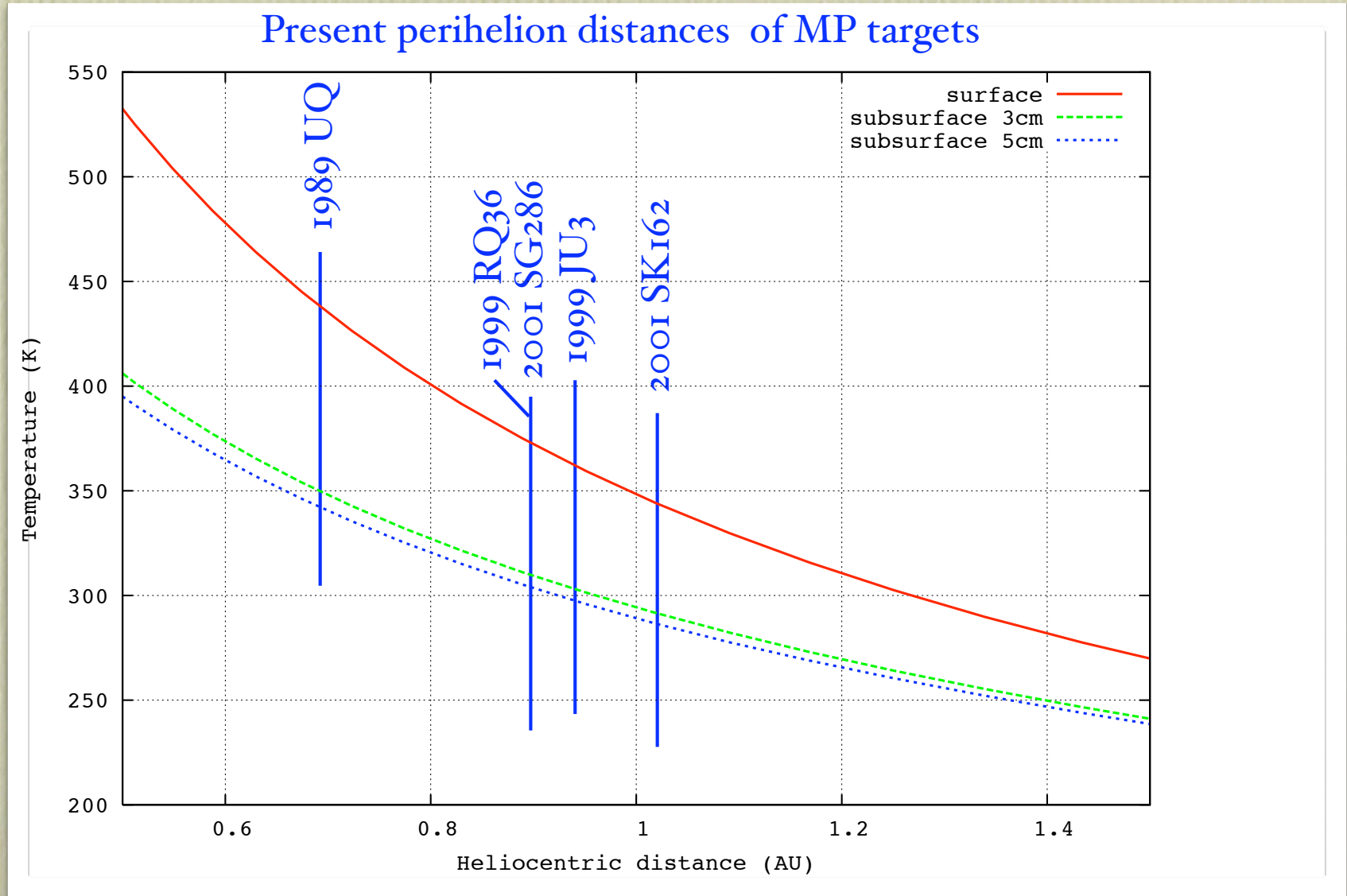


7h rotation period,  
thermal inertia =  
 $700 \text{ J m}^{-2} \text{ s}^{-0.5} \text{ K}^{-1}$   
Campins et al., 2009  
submitted



Temperature above which a 50% fraction of the surface  
(subsurface) area of an NEO is heated to.

# Temperature of targets today

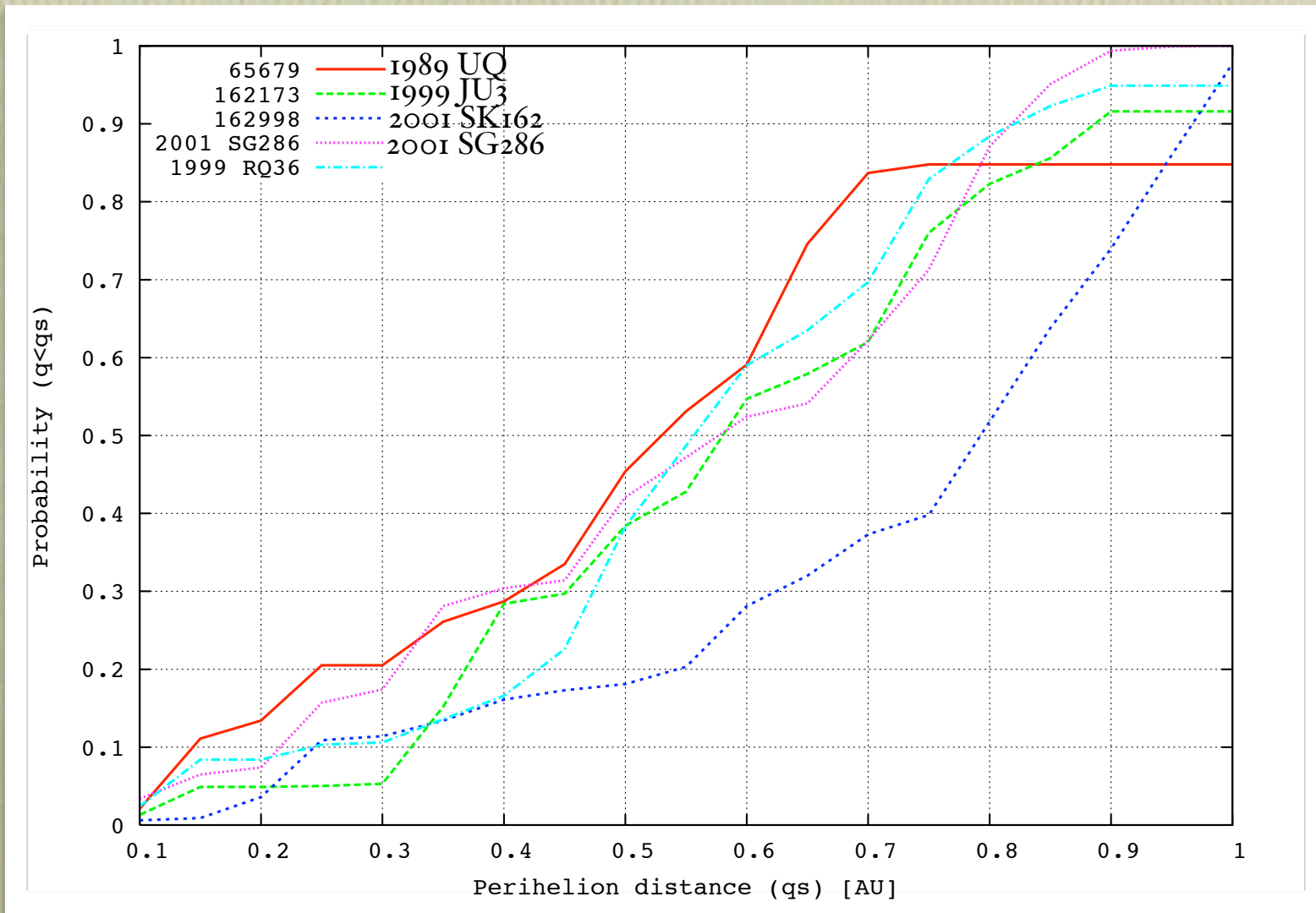




# Past orbital evolution

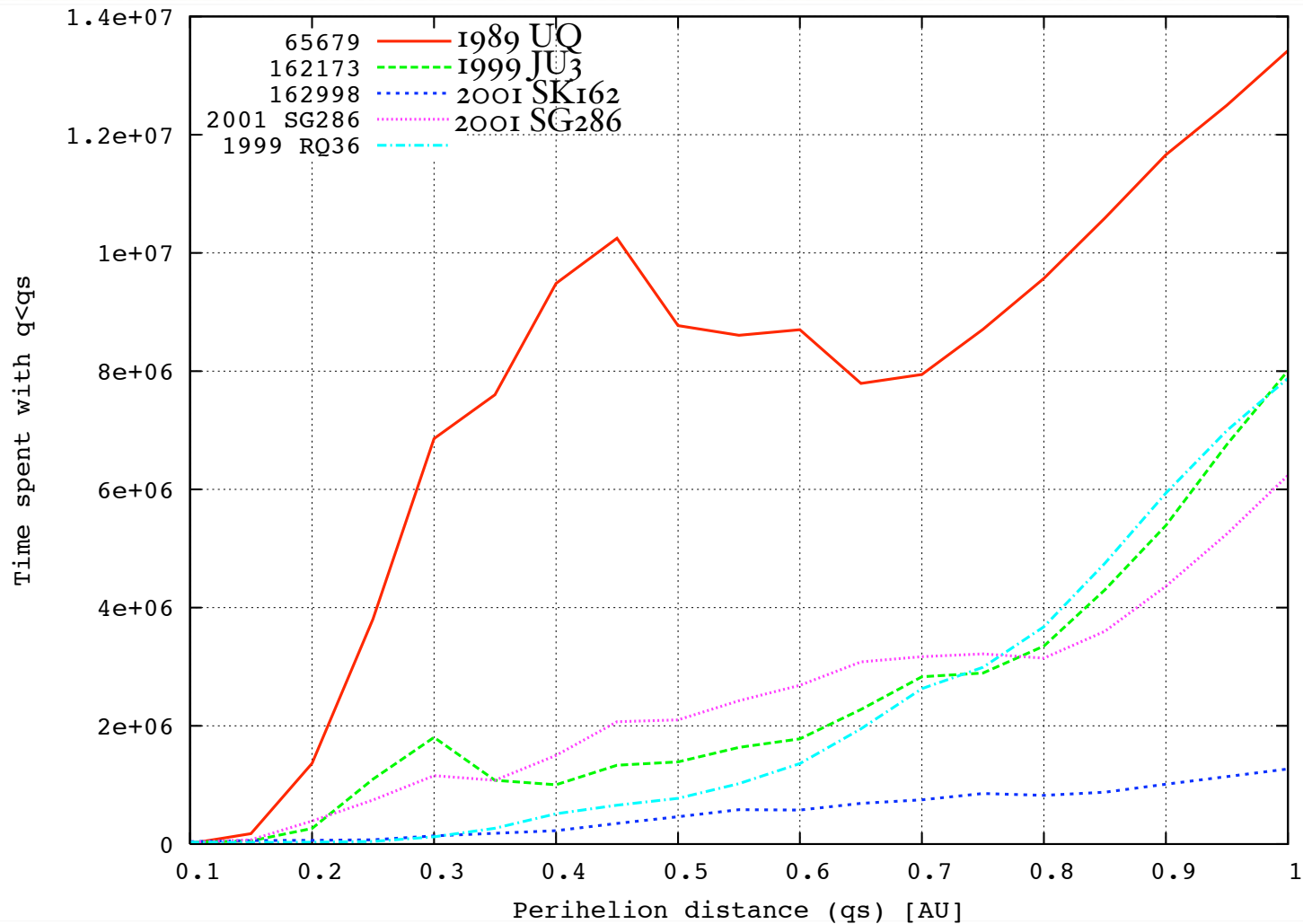
- NEOs evolve rapidly in the Keplerian orbital elements space,  $(a,e,i)$ , due to a combinations of close encounters with the terrestrial planets and resonances with the giant planets.
- The probability that each NEO reached  $q < q_s$  (with  $q_s$  = a given threshold)
- The total time spent at  $q < q_s$

# Probability of $q < q_s$

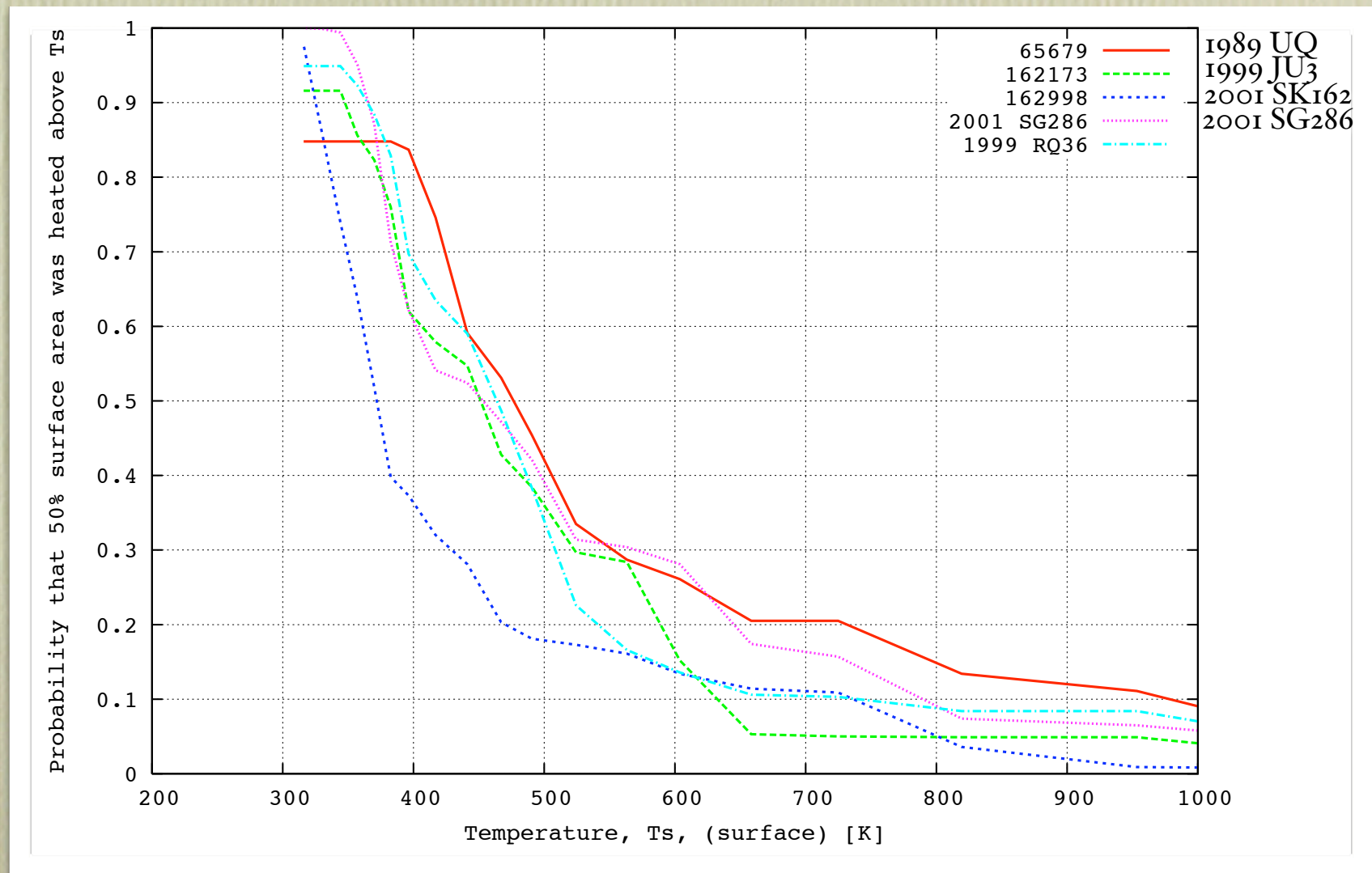




# Time spent with $q < q_s$

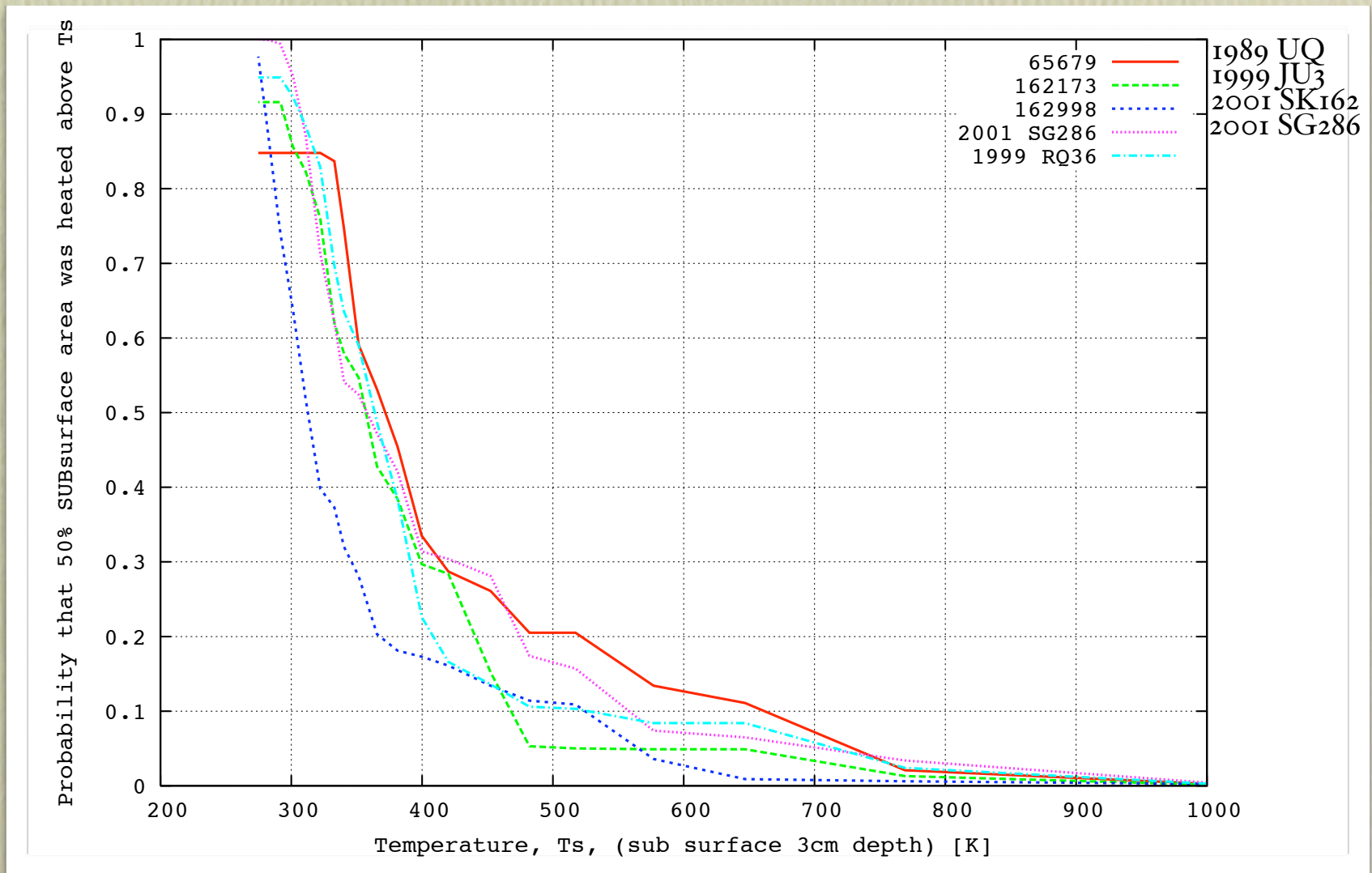


# Probability that targets were heated above a certain temperature (SURFACE)

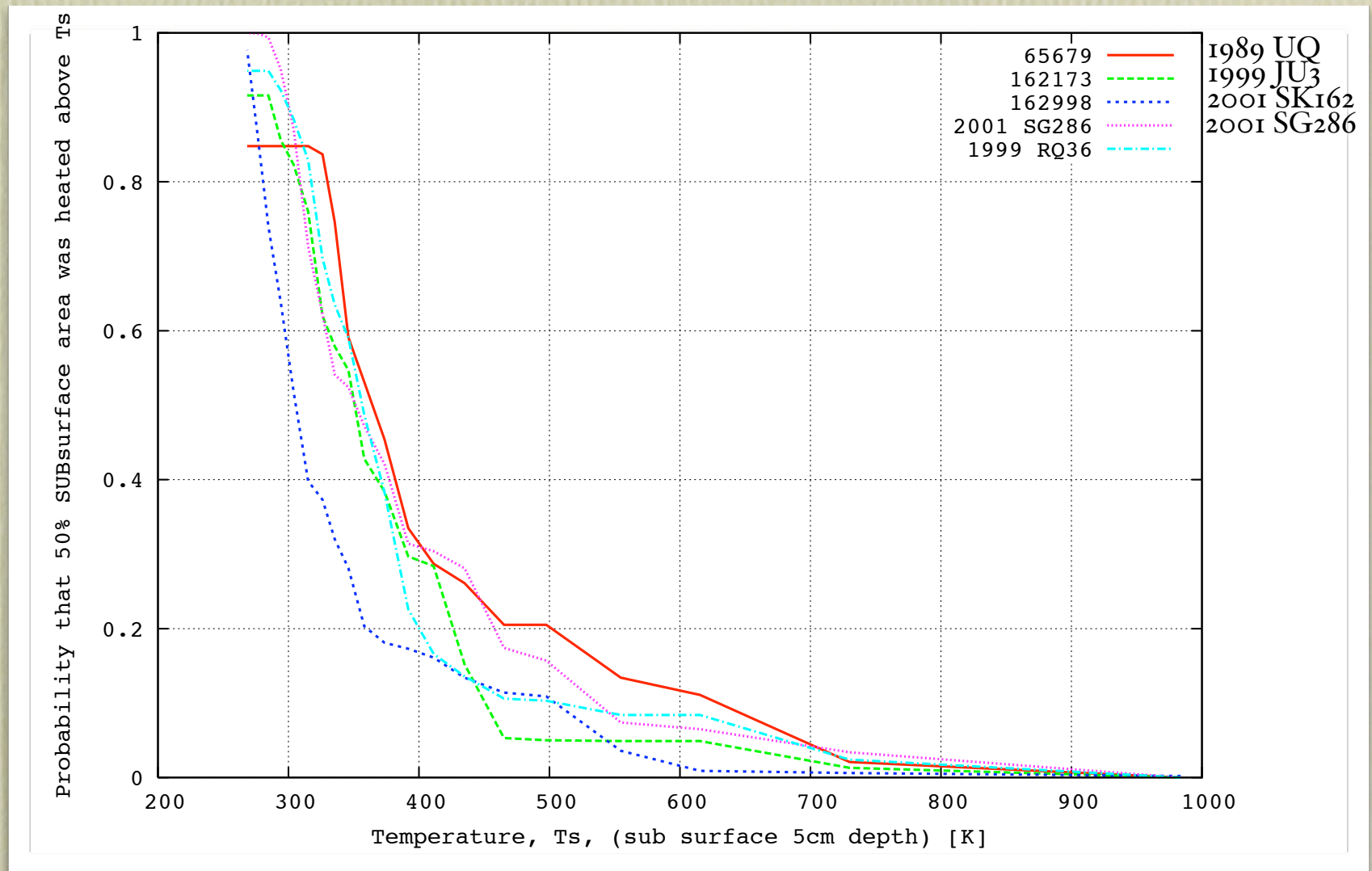




# Probability that targets were heated above a certain temperature (SUB-SURFACE 3cm)



# Probability that targets were heated above a certain temperature (SUB-SURFACE 5cm)





# Conclusions

- All target NEOs are likely to have been heated above 350 K at the surface.
- Heating at some (3-5cm) depth is less important.
- The less heated target is (162998) 2001 SK162.
- Subsurface sampling is required.