The solar ice-salt sheets

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The ice(CO_2+H_2O) occurs in the polar caps on Mars and in the red planet's soils[1,2,3,4,5,6,7&9]with huge outflow channels[8,9]. NASA[9] also prepared pictures which show frozen surfaces on Titan ,Jupiter's moon Europa[10]Callisto and Ganymede[9] . A type of different (hot)snows of salt may exist in top of the mountains on Venus(see pictures in [9]). The salt is as old as the Solar System, so the water trapped inside the salt is also ancient[11]. Both sulfate and chloride contaminants are plausible constituents of icy shells[12].The ice in solar system is as rock consist of ice,salt,minerals and rocky fragements.All the mixtures of ice and rocks flow but in different rates[14,15], although the ice flow slowly in cold conditions in compare to Earth[13]. Rock salt is unusually soft [19] and is probably close to the extreme in natural solid state rock flow[16,17&18]and flow elastically or elastic plastic and plastically during minutes,days,month and years[20,21,17].PDMS 36 is the best material for simulation the structures in most flowing situations[22,21, 17,13,18,14,15,23]. Rectangular sheets of PDMS used to understanding the steady state flow in a horizontal surface [22,21,17,13,18,14,15&23]as following the Ramberg's methods[24]. For unsteady flow used the prototype materials[23].Different roles played by viscous forces and viscous stresses, the differences in behavior of stagnation pressure and stagnation enthalpy , and the role of viscous stresses on the boundary in creating these behaviors in author's ice models. The ice can move by steady laminar flow or transitional flow, but it may turbulent in the deeper part when the ice is warmer. The ice in the polar areas(e.g. Mars) mostly considered that feed from above[25,7&26].The ice in all planets can flow sideways as viscous material(Fig1[13]) from a conical shape(Fig3) or rectangular shape to a droplet(Fig1). Planar passive markers that begin parallel to flow trajectories remain planar as they are carried by slow steady flows (Fig1). The roll over folds are developed as a result of trajectories of steady 3D flows crossing passive planar markers(Figs1&2).The evolution of vertical and horizontal markers during and steady flow of ice sheets shown in Figs 1&2.The pushed from top happened in the sheets , when the material inserted from top(Fig2). The down sinking sheets in below flow sideways as thick sheets and with medium rates(Fig2b,c) but the sheets in the load steady flow but in high rate. The weight of upper sheets creates a thin layer of liquid water that lubricates them and makes gliding possible(Figs2b,c). The sheets then stick together and progressive as larger scales(Fig2c).The ice propagates further during time(Figs1,2) to form the tank track folds[24,21]. In the case of changing atmospheric temperature/pressure and the ice sheet content, and also other articles(e.g. salt), polar ices generated compositional layering(Fig2c) , with multi roll over folds and ,oscillatory refolded folds. (Figs1).

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When the supply from top decreased or finished ,as well in the predominant atmospheric temperature and pressure, the liquefaction of the ice and the thermal contraction-expansion generated joints and fractures in ice and ice-salt mixtures , which the ice flow upward as liquid-solid material to generate pit like features(Fig1d).

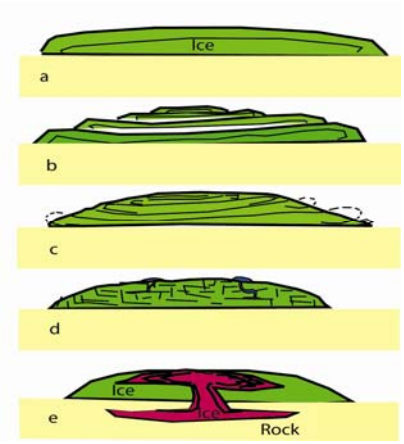

Fig1

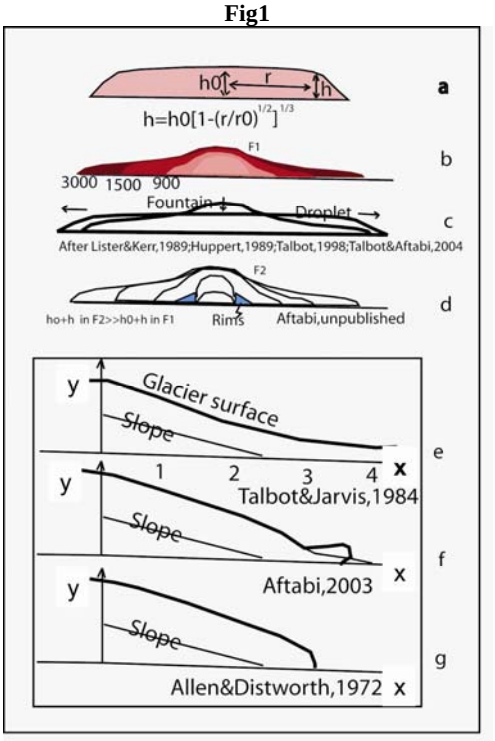

Fig2

Some of the pit shape structures may generated by convectional movements and rising(Fig1d) of ice or high content brines(e.g. on Mars). However the ice feeding from top may lead to loading of the older ice –salt sheets(e.g. on Mars) and formed rising ice- salt sheet , which injected to the new sheets(Fig1e)and spread sideways into it.

The layers thinned by fast steady flow and the folds change to tight, but in the slow flow layers be thicker. Three types of external structures simulated in the plastic, viscous and granular materials[21].The viscous materials in nature considered in two type structure[27,21].The fountain model[28] and the droplet models[29]later evolved to several sub-types[30].These forms also models in analytical methods([31,32]Figs 2e,g).However the natural salt glaciers under slope generated a taper, when the erosion is too low, or very gentle slop semi parallel to the main rock slope in below(Fig2f).In nature Viscous fluids flow down pressure gradients under the influence of boundary conditions[20,27].For example the external shape of the Southern polar cap of Mars probably show a viscous droplet , but the Martian Northern pole is as plastic conical shape. This means that the water may rise in the Northern pole. It is possible that the rate of spreading(or rise) in N and S is different. The rising water in the Northern pole may is higher than the southern polar cap, but it may start to flow sideways, even more rapidly. The experiments show that all viscous materials (without supply)flow sideways and changed the shapes from a plastic shape to a droplet viscous shape(Figs 3&4). The experiments(Fig3)are applicable for all Solar system ice caps.

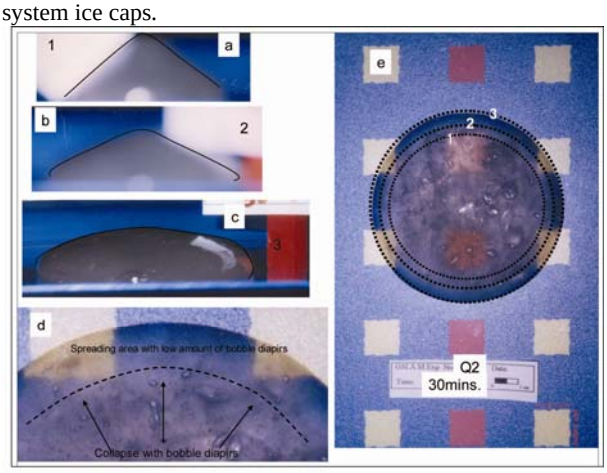

Fig3

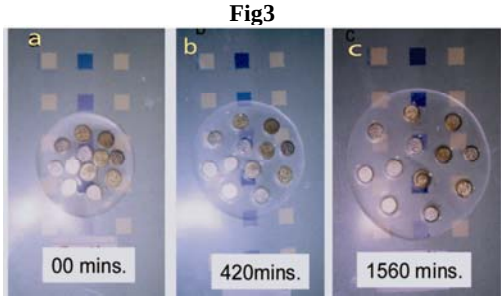

Fig4

They are granular(Fig3a) if the inserted ices from above are more than spreading ice-salt sideways. This shape also occurs when the rate of rise of the brine is so high and the freezing happened at the same time(like processes in volcanoes or ice volcanoes on Earth). However the ice or salt glaciers flow down slop base on analytical models, physical models and also natural models(Figs3e,f,&g).The ice acted as viscous-plastic material, which are changing together in external structures in the solar system(Fig3).However many inclusions(rocks) in the spreading sheets(like duricrusts) propagate sideways(Fig4),but sink during flow. The sinking rock articles in ice may leads to the injection of fresh water up(Fig1d) and then sideways. The inclusions, loading changes, competence contrast of layers, pre-existing joints-faults[21] and ice thin skin deformation[14,15,and 20] in the viscous sheets on Earth operated on the steady flow and generated folds(Fig5)by changes in the flow rate. They sink into the base and slow the spreading rate in termini, but fast the flow rate in back(Fig5[20]).The changes from steady state flow to variable flow (fast or slow)changed the shaping of tank track folds in nature([20];Fig5).The models here can be use for ice, salt and other viscous material elsewhere in solar system, to understanding flow laws. The shaping and rate of spreading in ice sheets and other viscous sheets like salt can help us to understanding brines material properties in the icy crusts and water explorations elsewhere in the solar system.

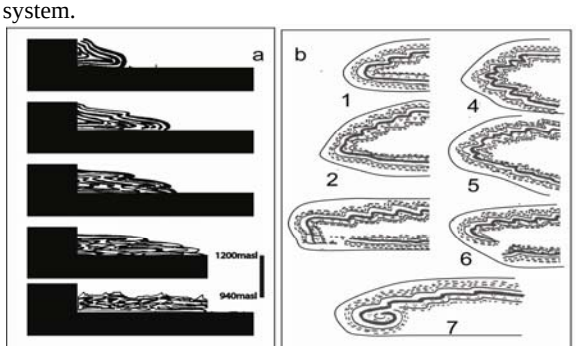

Fig5

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