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Preliminary observations of organic and fine inorganic sediment content of surface ice on the Huayna Potosi West Glacier, Bolivia

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Debris on glacier surfaces is linked with increased melt rates. Observations of glaciers in west China has suggested that black carbon deposited on the surface might accelerate the melt rates, the reduced albedos being over 5% due to black carbon deposits. Glacier surfaces can also support unique microbial food webs dominated by organic and inorganic debris called 'cryoconite' which can influence the surface albedo by cementing dark particles and organic debris together. This study aimed to make a preliminary assessment of the organic and fine inorganic sediment content of surface ice samples.

80 samples were retrieved from the Huayna Potosi West Glacier in May 2017. Glacier surface samples were collected by scraping the ice surface with an ice axe adze and placing the collected debris and ice fragments into a sample bag (hereafter called 'surface samples'). Glacier ice samples were collected using the ice axe adze to dig a 10cm depression in the ice from which broken ice fragments were retrieved and placed in a sample bag (hereafter called 'ice samples'). All samples were melted and the water/sediment mixture subject to standard gravimetric analysis to assess suspended sediment concentration (SSC). Dried filters plus sediment were then placed in a furnace at 500oC for 1 hour to burn off and indirectly measure organic matter content (%OM). The spatial distribution of the samples was designed to (1) allow comparison of the ice margin (ablation zone) and a region 200m up-glacier (mid-glacier), and (2) compare surface with glacier ice samples.

The mean SSC of mid-glacier ice samples was 117.6 $\pm$ 24.3 mg/L (n=18) compared to 6542.9 $\pm$ 2231.2 mg/L, (n=20) for ablation zone ice samples, and 4403.2 $\pm$ 5436.9 mg/L (n=16) for surface samples taken in the ablation zone. The mean %OM of mid-glacier ice samples was 30.5 $\pm$ 6.1 compared to 4.6 $\pm$ 0.7 for ablation zone ice samples, and 5.6 $\pm$ 0.6 for ablation zone surface samples. The mean SSC value of ablation zone ice is a factor of 55 higher than the mid-glacier samples. This could be due to fine sediment in ice being concentrated due to ice melt or to wind-blown fine sediment (dust). The middle glacier, at that time of year (early winter) is the snow accumulation zone. %OM is significantly higher in the mid-glacier samples and could be linked with the formation of cryoconite.

There appear to be few studies of SSC within glacier ice, although there are a number of papers concerned with glacier debris cover, albedo, cryoconites and melt rates. This short study carried out in Bolivia gives some preliminary observations of SSC and %OM variations. The range is high and there appear to be significant differences between the mid-glacier and the ablation zone in both SSC and %OM. The mid-glacier samples have lower SSC values but higher %OM than the samples collected in the ablation zone. Further microscopic examination of the sediment and its origins might help explain these differences.