Features of karakoram glacier surges

What are the typical features of Karakoram glacier surges?

The Karakoram is part of a complex of mountain ranges at the centre of Asia, where the borders of five countries all converge (Editors of Encyclopædia Britannica, 2016). Glacial surges are glacial advances at velocities up to one hundred times faster than usual (Sinha and Ravindra, 2012, p. 38). When examining Karakoram glacier surges it appears they are different to other surge clusters in the world. The surges tend to be brief events, with exceptionally high velocities, initiation and termination phases are rapid and the surges do not seem to be seasonally controlled (Quincey et al., 2015, p. 1299).

One typical feature of Karakoram glacier surges is that they are short-lived events, usually lasting 3-5 years. When Drenmang Glacier surged in 1930 and 1977 both events only lasted a year (Hewitt, 2007, p. 185) and a Shakesiga Glacier surge in the 2000's only lasted 1-2 years (Quincey et al., 2015, p. 1298). Their brief nature means there have been a huge number of surges over the last 150 years. There have been 34 surges since the 1860s involving 23 glaciers. Four tributaries of Panmah Glacier have surged in less than a decade, three in quick succession between 2001 and 2005. Since 1985, 13 surges have occurred in Karakoram, more than in any comparable period since the 1850s. (Hewitt, 2007, p. 181). Although Karakoram glacier surges are generally short-lived, they are actually longer surge events when compared to surges in Alaska.

Another typical feature of Karakoram glacier surges is their extremely high velocities, usually reaching 2km a $^{-1}$. The Bualtar glacier experienced a

mean surface velocity of 2. 77 km a $^{-1}$ during a 1986 surge, compared with a 146m a $^{-1}$ surge during the previous summer (Copland et al., 2009, pp. 1-2). Between 2006 and 2007, the North Gasherbrum glacier surge had a velocity wave of 3km a $^{-1}$ and, the peak velocity advanced from 15. 5 to 18. 5 km (Mayer et al., 2011, p. 908). In the case of the Braldu surge between 2013 and 2014, there was a clear velocity wave of approximately 2 km a $^{-1}$ (Quincey et al., 2015, p. 1293). These velocities are the most likely cause of what makes the surge such a quick event. The Karakoram surge velocities are faster than other surge velocities across the world, where the velocities tend to reach only a few thousand m a $^{-1}$.

A third feature of Karakoram glacier surges is their rapid initiation and termination phases, lasting months to years. Surge initiation and termination phases refer to the start and end of the surge. Termination occurs after the surge, when the glacier has become virtually stagnant (Singh, Singh, and Haritashya, 2011, pp. 416-417). During the late summer of 2009 the Shakesiga Glacier flowed at 400 m a $^{-1}$, but reached its maximum velocity of 2000 m a $^{-1}$ by midsummer of 2010, indicating the initiation phase took place during winter. Shakesiga surge decelerated to 1100 m a $^{-1}$ and terminated during the early winter of 2010 (Quincey et al., 2015, pp. 1292-1293). However, Alaskan glacial surges have a much more abrupt termination phase than initiation phase, tending to last several days as opposed to months (Quincey et al., 2015, p. 1297).

A final typical feature of Karakoram glacier surges is that they do not seem to be seasonally controlled. Surges usually initiate during winter months

when drainage efficiency is low and terminate during summer months, when drainage efficiency is high (Quincey et al., 2015, p. 1288). However, this is not the case in the Karakoram region as surges have initiated and terminated in irregular months. The Skamri Glacier initiation phase took place more toward the summer season than the winter and the Shakesiga surge initiated and terminated during winter months (Quincey et al., 2015, pp. 1292-1293). This suggest that Karakoram surges are thermally rather than hydrologically controlled, coinciding with high-altitude warming from long-term precipitation and accumulation patterns (Quincey et al., 2015, p. 1290). If Karakoram glacier surges are thermally controlled it may explain why their features are different to other surge areas in the world.

The features of Karakoram glacier surges are an anomaly when compared to other surge areas in the world, such as Alaska, although they do share many similarities with Svalbard glacier surges. Their characteristics have led many geographers to the conclusion that they are thermally controlled and this could be a possible cause of their differences compared with other glacier surges. Yet the dominant surge mechanism still remains unclear.

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