Referee #2 (RC C8351)

General comments: Overall, the paper describes interesting research, which involves good science, to evaluate the microbial abundance and live proportion in ice cores. This paper suffers from several fatal flaws that prevent it from being publishable at this time, but I do believe that the data is important, and hope that the authors are willing to put in the necessary time and energy to fix these issues so that it can be published.

The main issue with the manuscript is that the hypotheses and how they were tested are not clearly articulated. The entire research project is stated as though it is intended to differentiate between aeolian deposition and post-deposition microbial processes, i.e. wind deposits microbes and they stay put and do what they can vs. wind deposits microbes and they move through the snow and icepack changing distribution and abundance throughout. However, there is no explicitly described result from the methods presented that would prove or disprove one or the other hypothesis. Furthermore, this is not done in the discussion, where both microbes-associated-with-dust and microbes-not-with-dust are both described as evidence of the aeolian deposition. Further, it was not clear from the methods how the authors told the live cells from the dead. Also, it was not clear why no diversity analyses were used. Finally, the lack of clear statistics for hypothesis testing was most distressing, as this is absolutely crucial to publish these data.

REPLY FOR THE HYPOTHESIS QUESTION: Our previous studies showed that the microbial load was controlled by the strongly aeolian activities (Yao et al., 2006; Xiang et al., 2009a and 2009c), but the community distribution of microorganisms in the deep ice was influenced by the post-deposition as a result of microbial growing in the surface snow (Xiang et al., 2009c). However, the behavior of aeolian activities and its influences on the microbial distribution in the deep ice is unclear (see the detailed introduction section from line 32-48 in the new MS version). We tried to discuss it as follows:

Dust deposition and it relates to the microbial deposition: The previous and current results showed that microbial abundance was frequently associated with high concentrations of particles. This indicates that wind carries both dust and microbes in the atmosphere onto the glacial surface, suggesting the importance of dust deposition on the distribution of microorganisms in the ice, implying aeolian activity being an agent for microbial transport on the glacial surface (lines 139-149).

Live cell density variation and it relates to the temperature changes over the glacier: As presented from lines 150-175 in the discussion section 4.2 in the new MS version, our new data from the Muztagata Glacier showed clear seasonal patterns with high microbial abundance occurring in either cold winter-spring (open triangle in Fig. 2a) or warming summer seasons (filled triangles Fig. 2a). It is not surprise for the high live cell density in summer as a result of microbial growing in the surface snow; While the high live cell density in the winter-spring is possibly attributed to the high microbial load by wind during the frequently storm periods. This suggests the interactive regulation of both aeolian- and post-deposition mechanisms on the distribution of microorganisms in a glacier (Xiang et al., 2009c). This is the first report about the seasonal changes of live cell density in the ice. More information on the seasonal characters of microorganisms in the ice is necessary before a definite conclusion is drawn.

Geographically driven microbial density differences: Microbial comparisons among the neighbouring glaciers display a heterogeneous spatial pattern (lines 181-183 in the new MS version), with the highest microbial cell density in the glaciers lying adjacent to the central Asian deserts and lowest microbial density in the southwestern margin of the Tibetan Plateau (discussion section 4.2, lines 212-213 in the new MS version). This coincidence strongly reinforces our hypothesis of aeolian activities being the main agents controlling microbial load in the glacier ice.

Reply for the question of differentiation of the live from dead cells: Three groups of bacteria can be identified based on the difference of the bound probes: cFDA-stained, cFDA/PI-double-stained and PI-stained group, indicating viable, injured, and dead cells, respectively (Xiang et al., 2009c, lines 91-93 in the new MS version).

Reply for the community diversity question: The community structure geography has been discussed (Xiang et al., 2010). Here, we will discuss the biogeography of microbial cell density across the mountain glaciers in western China. (lines 181-183 in the discussion section in the new MS version).

Reply for the snow-ice turnover question: Field observations and previous data have showed a good preservation of the seasonal temperature changes along the ice core depth profile from the Muztagata Glacier (Tian et al., 2006). This makes it possible for us to explore the seasonal profile of microbial cell density and relate it to the temperature changes over the glacier (lines 60-64 in the new MS version).
See the detailed information of reference sources: The gradual increase of ice density due to the densification of firn layers shows that the glacier has not overturned at the drilling site. The extremely low air temperature at over 7000 m limits the possible melting of surface snow. Recurring strong winds on the glacier do remove part of the fresh snow; however, the in situ observation shows that a hard layer forms on the snow surface with these winds which prevents further erosion of the fresh snow surface…… In addition, four $\delta^{18}O$ profiles along the glacier at different altitudes also show that the seasonal variation of $\delta^{18}O$ was well preserved in the snow layers of the Muztagata glacier (Tian et al., 2006).

SPECIFIC COMMENTS,
QUESTION: P 14532, line 25 - ": : : that causes climate changes Basin: : :" Unclear what the meaning is.
RE: This sentence was corrected to “it is uncertain how aeolian processes, that drive the air mass and climatic changes (Wake et al., 1993; Davis et al., 2005), control the distribution of microorganisms in the glacier ice.” (lines 30-32 in the new MS version).

QUESTION: P 14533, line 6 - ": : : abundance of microbial abundance: : :" is redundant.
RE: This was corrected to “All results of the ice cores have showed a high microbial abundance corresponds with a high concentration of particles……” (lines 36 in the new MS version).
QUESTION: P 14535, line 14-15 - what do you mean by decontaminated?

RE: This was corrected to “The outside layers of the ice core sections were moved out, and the inner sections were slowly melted……” (line 86-87 in the new MS version).

QUESTION: P 14536, line 21 - looks like you may mean "The density: : :" rather than "The abundance"
RE: This was already corrected to “The high microbial cell density significantly correlated with the peaks of mineral particle concentrations” (lines 117-118 in the new MS version).

QUESTION: P 14540, line 5 - But that is a higher cell density than others presented, so how is it the lowest?
RE: This was corrected to “The lowest microbial cell density occurred in the Rongbuk Glacier which contained 9.4×10^4 cells/ml” (lines 200-201 in the new MS version).

QUESTION: P 14540, line 21 – in ": : : dust events dust origination: : : " which is it?
RE: This was corrected to “dust events and dust origination centers” (line 213 in the new version of MS).