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Recent development of optically stimulated luminescence dating techniques and implications for chronological framework of Paleolithic and paleoanthropological sites in Northern China

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FIRST PARAGRAPH: Optically stimulated luminescence dating method can be applied to obtain depositional age or burial age of the sediments in a variety of sedimentary environments. The physical basis of this method is that mineral grains are exposed to the sunlight/daylight during the transportation; hence the previously stored luminescence signals in the minerals are set to zero upon deposition. The decay of the radioactive nuclides in the sediments will generate radiation which interacts with the sediment grains, in essence, transferring energy from the ambient environment to the mineral grains and the amount of the energy stored in these grains being proportional to the time since their last exposure to the sunlight/daylight. To establish chronology for Paleolithic archaeological sites, a common approach involves dating of the sediments above and below the layers which yield artifacts or fossil remains. The ages of the sediments embracing the cultural layers provide constraints on the time of the human occupation or other activities at the sites.

光释光测年技术的最新进展及其在中国北方旧石器考古和古人类遗址点年代框架研究中的意义

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首节：光释光测年方法可以用来测量各种沉积物的埋藏年龄，其物理原理是：沉积物的矿物颗粒在搬运过程中经过光的晒退，使其以前积累的光信号归零，在后期埋藏过程中由于沉积物中放射性核素的衰变发射出具有一定能量的射线，这些射线与矿物颗粒的相互作用将能量从周围环境中转移到矿物颗粒中进行储存,而其储存信号的多少正比于这些矿物颗粒最后一次见光以来的时间。在建立考古遗址点的年代框架过程中，通常是测量考古遗址点含石器或化石遗存层上下沉积物的年龄。与文化层相关的沉积物年龄可以给出古人在遗址点生活的时间。

Recent development in the luminescence methodology has led to great improvement in the applicability and precision of luminescence dating. However, there has been an apparent age limit around 100ka, i.e. samples from obviously older layers tend to yield luminescence ages around 100ka. This has caused major confusion in the establishment of the chronology of several important Paleolithic sites and in the interpretation of the cultural remains unearthed. Several factors may contribute to the apparent age underestimation. Here we report preliminary results of our recent chronological studies at several sites around Nihewan. We show that many of the debates on chronology stem from the difference in the interpretation of the dating results. Further, some of the previous dating studies were limited by the choice of the laboratory protocols. In this report, we compare the dating results of different methodologies and in particular we show that the use of feldspar fractions extracted from the sediments can lead to significant extension of the age limit compared to that of the quartz-based techniques. Combined with detailed stratigraphical investigation in the field, our dating results point to significantly older ages for the cultural

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layers at the sites of our study. We therefore suggest that interpretation of the Paleolithic remains at the sites in northern China and the correlation with other regions must take into account this new development in luminescence dating and the use of the previously published luminescence ages (~100ka) must be made with caution.

随着光释光测年技术的发展，释光方法得到了广泛的应用，其测年精度有了很大的提高。已有的释光年龄往往出现一个在~100ka附近的“极限”年龄，如，采自于明显老于100ka地层的沉积物样品，释光测年的测量结果仍然为~100ka，这极大限制了我国一些重要考古遗址点年代框架的建立和对文化遗存的解释。若干不同因素会造成释光年龄的低估。这里我们介绍泥河湾地区几个旧石器遗址点的释光测年初步结果。结果表明，关于年代的争论多源自于对测年结果的不同解释；显然，以前一些测年结果受到了当时实验室技术方法的限制。在本研究中，我们对比了不同方法的测年结果，我们提取了沉积物中的长石矿物组分进行测量，长石矿物的测年范围比石英矿物有了显著的提高。结合详细的野外地层观察，我们在研究区若干旧石器考古地点的测年结果均给出了较以前研究更老的年龄。我们建议在解释中国北方旧石器考古遗存和与其它遗址点的关系时必须考虑光释光技术的进展和最新的测量结果，在使用以前释光测年结果 (>~100ka)时需要谨慎。