十九、86 道班活动断裂诱发移动冰丘及灾害效应

乌丽盆南发育近东西走向的活动断裂，切割错断晚更新世—全新世地层和现代水系，在青藏公路 86 道班东、西两侧形成比较开阔的断层谷地，成为地下水运移、富集的良好场所，夏季形成构造融区和低温温泉，冬季形成不同规模的移动冰丘或冰丘群，命名为 86 道班移动冰丘（吴珍汉等，2003f，2004，2005）。2001 年 3 月乌丽 86 道班东侧冰丘规模较小，高度小于 80cm；至 2002 年 1-2 月，由于断裂活动和地下水运动，乌丽 86 道班东侧冰丘中心位置向南西迁移约 7m，移至公路涵洞东约 4-8 米处，形成宽 8m、长 15m、高 2-2.5m 的较大移动冰丘。2002 年 86 道班移动冰丘对格尔木—拉萨输油管道产生了显著破坏，导致长达 15 米的地下输油管道发生高约 1.5-2.0 米的拱曲变形。2002 年 8 月，管道管理部门派技术人员将弯曲变形的输油管道拆除，用新的管道进行替换，并重新埋设于地下一定深度；通过在管道上方填埋了粗大石块和砾石，良好地疏通了地下水，避免了上涌泉水在断裂破碎带的再次富集，冬季没有形成新的冰丘，收到良好的防灾效果，为青藏高原常年冻土区断裂诱发移动冰丘的工程防治提供了有益经验。

2003-2004 年冬季，在青藏公路东侧 2002 年 2 月冰丘的北东和南西两侧，各形成 1 个新的移动冰丘。西南侧的移动冰丘规模较大，呈圆锥状，锥底直径约 16m，锥顶高 1.8-2.0m。东北侧的移动冰丘规模较小，直径 12m，高 94cm。由于乌丽 86 道班移动冰丘偏离公路和铁路，暂时没有对道路交通和运输安全构成威胁。

PART 19 86TH STATION MIGRATING PINGOS POSED BY ACTIVE FAULTING AND THEIR HAZARD TO OIL-PIPELINE

In south of Wuli basin there exists a nearly E-W trending active fault that cuts Late Pleistocene deposits and offsets Holocene stream, formed fault valley near 86th station of Highway which services as good conduits for surface and underground water flow. In the fault valley thawing ponds and low temperature springs appear in summer, and migrating pingos form in winter named as 86th station migrating pingos (ESP). In March 2001, ESP pingo formed in east of Wuli 86th station is as lower as 80cm. In January-February of 2002, the center of ESP pingos migrated 7m southwestward due to active faulting to 4-8m east of the Highway culvert, and the larger migrating pingo appears as 15m long, 8m wide and 2-2.5m high, lead to 1.5-2.0m upward bending of the buried oil-pipeline of 15m long. In August 2002, management agency in charge of the Golmud-Lhasa oil-pipeline replaced the bended oil-pipeline by new one and buried it back to its original position beneath ground surface to certain depth. The engineers covered the pipeline with mixture of rocks and pebbles that are favorable for underground water flow and prevented well the accumulation of spring water in summer and the formation of Pingos in winter. This gives a successful example to prevent geological hazards of migrating pingos for engineering facilities by underground drainage measures.

In winter of 2003 and March of 2004, two new pingos formed in northeast and southwest sides of former position of migrating pingo in south Wuli fault valley. The southwest migrating pingo appeared as large and cone-shaped and was 16m in diameter and 1.8-2.0m high, and the northeast pingo appeared as smaller one being 12m in diameter and 0.94m high in March of 2004. Fortunately, migrating pingos of ESP occurred far away from the Golmud-Lhasa Railway and did

not produce hazards to railway line.

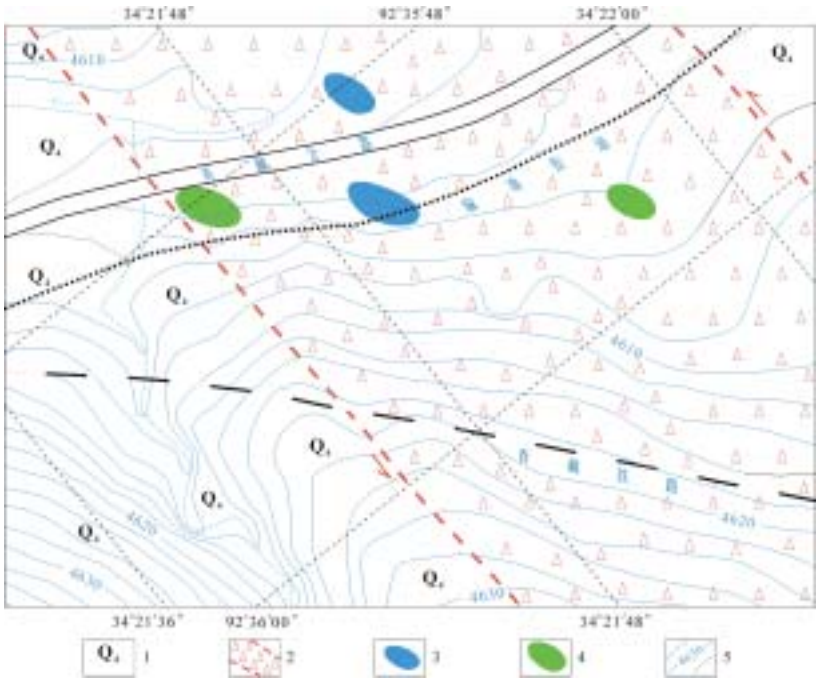


图 232 乌丽 86 道班平面地质图

图例说明：1-全新世砂砾石；2-隐伏断裂破碎带；3-2002 年 2 月移动冰丘；4-2004 年 3 月移动冰丘；5-等高线（m）。

Fig.232 Quaternary geological map of Wuli 86th station of the Highway. Explanation: 1-Holocene sands and pebbles; 2-covered fault breccia; 3-migrating pingo appeared in February of 2002; 4-migrating pingo appeared in March of 2004; 5-elevation coutour (m)



图 233 乌丽山南断裂左旋错断冲沟

（镜头向北西，摄于 2002 年 2 月）

Fig.233 View northwestward in February of 2002 at sinistral slip of stream along active fault in south of Wuli Mts.



图 234 乌丽 86 道班断裂破碎带

（镜头向西，摄于 2004 年 7 月）

Fig.234 View westward in July of 2004 at breccia of active fault in south of Wuli Mts.



图 235 乌丽 86 道班公路东侧 2002 年 2 月移动冰丘

（镜头向东）

Fig.235 View eastward in February of 2002 at migrating pingo of ESP in east of the Highway



图 236 乌丽 86 道班公路东侧 2002 年 5 月部分消融的移动冰丘

（镜头向东）

Fig.236 View eastward in May of 2002 at partially thawed migrating pingo of ESP in east side of Highway



图 237 乌丽 86 道班公路东侧 2002 年 6 月移动冰丘消融露出拱曲变形的输油管道

（镜头向东）

Fig.237 View eastward in June of 2002 at upward bended oil-pipeline after thawing of ESP migrating pingo



图 238 乌丽 86 道班公路东侧 2002 年 7 月移动冰丘导致输油管道的拱曲变形

（镜头向西）

Fig.238 View westward in July of 2002 at upward bended oil-pipeline in east of Golmud-Lhasa Highway



图 239 乌丽 86 道班公路东侧 2002 年 7 月移动冰丘拱曲破坏公路桥涵

（镜头向东）

Fig.239 View eastward in July of 2002 at destructed culvert of Highway by freezing expansion of ESP pingo



图 240 乌丽 86 道班公路东侧输油管道修复后用碎石填埋管道周围疏导断裂破碎带泉水

（镜头向东，摄于 2003 年夏）

Fig.240 View eastward in summer of 2003 at replaced oil-pipeline covered by stones and pebbles near 86th station of the Golmud-Lhasa Highway



图 241 乌丽 86 道班公路东侧 2004 年 3 月沿断裂破碎带形成新的移动冰丘

（镜头向北西）

Fig.241 View northwestward in March of 2004 at new migrating pingos of ESP in fault valley



图 242 乌丽 86 道班公路东侧 2004 年 3 月见 2002 年冰丘遗迹东南侧发育新的移动冰丘
（镜头向南）

Fig.242 View southward in March of 2004 at bigger and higher migrating pingo of ESP in east of the Highway



图 243 乌丽 86 道班公路东侧 2004 年 7 月移动冰丘消融后残留的泉水坑
（镜头向南东）

Fig.243 View southeastward in July of 2004 at relics of completely thawed migrating pingo of ESP