2026 Open Fund Project Application Guidelines

State Key Laboratory of Coal Mine Disaster Prevention and Control

The State Key Laboratory of Coal Mine Disaster Prevention and Control (the "Laboratory") is led by China Coal Technology and Engineering Group Corporation. In support of China's national strategy for safe coal production and a stable energy supply, the Laboratory focuses on three major research areas:

- understanding the mechanisms underlying coal mine disasters;
- disaster sensing, monitoring and early warning; and
- efficient disaster prevention and control.

The Laboratory is committed to developing into a world-class national strategic scientific and technological research platform for coal mine disaster prevention and control.

To strengthen academic exchange and research collaboration, attract outstanding researchers from China and overseas to undertake fundamental, frontier and innovative research using the Laboratory's facilities and resources, and promote theoretical innovation and technological breakthroughs in coal mine disaster prevention and control, the Laboratory hereby publishes its 2026 Open Fund Project Application Guidelines.

Researchers working in relevant fields are encouraged to apply.

I. Research Topics

1. Construction and Dynamic Evolution of a Multi-Hazard Causal-Chain Network Model for Coal Mines

Research Scope

Focusing on three types of disasters—coal and gas outbursts, gas or coal-dust explosions, and fires—the project will investigate hazard-causing factors, coupling relationships, triggering pathways, and the conditions governing disaster propagation and transformation.

The project will:

- establish a causal-chain network model integrating the three types of disasters;
- examine the structural characteristics of the causal-chain network;
- identify critical hazard-causing factors and triggering pathways;
- investigate the transmission patterns and dynamic processes of hazard effects within the network;

- analyse how network nodes and their coupling interactions affect network characteristics;
- reveal the dynamic evolution of the causal-chain network; and
- establish a disaster-chain risk assessment model based on complex network theory and propose corresponding chain-breaking prevention and control strategies.

Expected Outputs and Performance Indicators

The project is expected to:

- establish a causal-chain network model for a compound disaster system involving coal and gas outbursts, gas or coal-dust explosions, and fires;
- identify the static topological characteristics and dynamic evolution patterns of the network;
- establish a complex-network-based disaster-chain risk assessment model capable of probabilistic inference of disaster evolution pathways;
- include no fewer than 150 risk factors in the causal-chain network model;
- assess structural characteristics including connectivity, centrality, vulnerability and clustering;
- validate the model using representative accident case data;
- achieve an accuracy of at least 80% in probabilistic inference of disaster evolution pathways;
- submit one research report;
- publish one SCI-indexed paper and one EI-indexed paper; and
- file two invention patent applications.

Funding ceiling: RMB 300,000
Technical contact: Mr/Ms Cheng, +86 186 2333 5152

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2. Intelligent Extraction of Acoustic-Signature Precursors for Coal–Rock–Gas Dynamic Disasters

Research Scope

This project addresses the complex coupling mechanisms associated with coal–rock–gas compound dynamic disasters under deep mining conditions, the sensitivity of

conventional gas and microseismic monitoring methods to environmental noise, and the excessive dependence of risk identification on single-sensor signals.

The project will:

- develop preprocessing methods for underground acoustic signals in high-noise environments, including denoising and missing-signal reconstruction;
- develop algorithms for dynamic extraction of time-frequency acoustic-signature features;
- establish an acoustic-signature database covering typical underground acoustic events, including equipment operation, gas emission, coal and rock fracturing, drilling and ground-support operations; and
- establish an intelligent acoustic-signature-based decision framework for classifying the risk levels of coal–rock–gas compound dynamic disasters.

Expected Outputs and Performance Indicators

The project is expected to:

- identify the time-frequency precursor characteristics of acoustic signatures under typical hazardous conditions associated with coal–rock–gas compound dynamic disasters;
- propose a system of acoustic-signature parameters and corresponding parameter-selection principles;
- develop an acoustic-signature-based risk identification algorithm;
- achieve an identification accuracy of at least 90% and a recall rate of at least 85% for high-risk conditions;
- complete field validation at no fewer than one mine and two working faces;
- submit one research report;
- publish two SCI-indexed papers; and
- file two invention patent applications.

Funding ceiling: RMB 200,000
Technical contact: Mr/Ms Pu, +86 133 8899 0429

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3. Coordinated Cuttings-Removal Mechanisms for Hydraulic Slotting in Along-Seam Boreholes

Research Scope

This project addresses the lack of understanding of cuttings-generation patterns during hydraulic slotting in along-seam boreholes, poor coordination between cuttings generation and discharge, and difficulties in maintaining effective cuttings removal.

The project will:

- conduct annular-cutting deformation and cuttings-generation experiments on briquetted coal specimens under different loading conditions;
- investigate the effects of loading conditions, coal hardness, water-jet pressure and water-jet flow rate on real-time cuttings volume, particle-size characteristics and cuttings-generation rate;
- establish dynamic cuttings-generation models under different loading conditions;
- analyse the transport of cuttings in mixed borehole fluids and the dynamic evolution of the carrying capacity of cuttings-removal pathways;
- quantitatively investigate the dynamic feedback and balance among cuttings generation, transport and carrying capacity;
- establish dynamic matching criteria for coordinated cuttings generation, transport and discharge capacity; and
- develop an efficient cuttings-removal method for hydraulic slotting.

Expected Outputs and Performance Indicators

The project is expected to:

- establish a dynamic cuttings-generation model for along-seam borehole slotting under different loading conditions, coal hardness levels and water-jet pressures;
- establish dynamic matching criteria for cuttings generation, transport and carrying capacity;
- develop a coordinated cuttings-removal method featuring high slotting efficiency, rapid cuttings transport and unobstructed discharge pathways;
- submit one research report;
- publish two EI-indexed papers; and
- file two invention patent applications.

Funding ceiling: RMB 200,000
Technical contact: Mr/Ms Guo, +86 173 5848 4217

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4. Staged Acid-Dissolution and Sand-Suspension Unblocking Method for Low-Production Coal Seam Gas Wells

Research Scope

This project addresses the loss of production in long-operating surface pre-drainage wells caused by complex sediment deposits blocking gas-production pathways.

The project will:

- investigate the formation mechanisms and production processes of complex sediment deposits in surface pre-drainage wells;
- examine the relationship between sediment composition and the molecular structure of unblocking agents;
- develop a compound acid-fluid and sand-suspension unblocking-agent formulation;
- investigate the effects of acid dissolution and sand-suspension-assisted removal on sediment discharge;
- clarify changes in the occurrence, transformation and spatial distribution of sediments before and after unblocking;
- determine the critical parameters governing sediment acid dissolution, sand suspension and removal under staged treatment; and
- propose a staged acid-dissolution and sand-suspension unblocking and production-enhancement method for low-production wells.

Expected Outputs and Performance Indicators

The project is expected to:

- develop a compound acid-fluid and sand-suspension formulation featuring controlled reaction, strong dissolution, high permeability and enhanced viscosity;
- propose a staged sediment acid-dissolution and sand-suspension unblocking method for low-production coal seam gas wells;
- achieve a sediment dissolution rate of at least 30% under standard laboratory testing;
- limit the corrosion rate of N80 steel coupons to no more than 5 g/(m^2·h);
- achieve a viscosity retention rate of at least 80% for the sand-suspension agent;

- demonstrate compatibility with formation water without abnormal precipitation, flocculation or emulsification;
- achieve an unblocking rate of at least 60% for actual sediment samples under laboratory-scale in-situ simulation conditions;
- submit one research report;
- publish two SCI-indexed papers; and
- have two invention patent applications formally accepted.

Funding ceiling: RMB 250,000
Technical contact: Mr/Ms Fu, +86 152 2329 1001

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5. Mine Ventilation Network Resistance Inversion under Prior Constraints

Research Scope

This project aims to accurately and rapidly determine the actual distribution of aerodynamic resistance within mine ventilation networks using measured airflow data.

To address the underdetermined nature and multiple-solution problem of conventional airflow-based resistance determination, the project will:

- introduce prior constraints to establish models with prescribed solution distributions;
- develop a unique-solution algorithm based on convex optimisation and compressed sensing theories;
- investigate the resistance-distribution conditions embedded in prior constraints and their effects on model performance; and
- investigate solution algorithms and performance when specific resistance-range constraints are added to the prior constraints.

Expected Outputs and Performance Indicators

The project is expected to:

- establish an airflow-based resistance determination model incorporating prior constraints;
- develop a ventilation resistance determination method based on prior constraints;
- achieve an error of less than 5% where the initial constraints are reasonably defined;

- identify the locations of conflicting constraints where the initial constraints are incorrectly defined;
- submit one research report;
- publish one SCI-indexed paper; and
- file two invention patent applications.

Funding ceiling: RMB 260,000
Technical contact: Mr/Ms Liang, +86 177 2389 6380

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6. Failure Mechanisms and Service-Life Improvement of High-Performance Power Drive-Rod Joints for Automated Drilling Rigs

Research Scope

This project addresses fatigue, fracture, thread wear and other common failure modes of power drive-rod joints.

The project will:

- establish a nonlinear dynamic model coupling geological characteristics, drilling parameters and vibration loads;
- simulate the evolution of forces under representative operating conditions;
- reveal the coupling mechanisms between stress concentration and fatigue damage;
- establish failure criteria and service-life prediction models;
- undertake multi-objective optimisation of structure, materials and manufacturing processes based on the identified failure mechanisms;
- optimise thread forms and high-strength, high-toughness materials;
- determine an optimum structure–material–process combination; and
- develop a high-reliability joint design and manufacturing method.

Expected Outputs and Performance Indicators

The project is expected to:

- develop one full-life-cycle fatigue prediction model and design optimisation software package for power drive rods;
- achieve a fitting accuracy of at least 90% for representative failure cases;

- prepare a complete set of optimised design drawings, a materials-selection guide and manufacturing-process specifications;
- ensure that power drive rods manufactured according to the optimised design support an average drilled distance of at least 1,300 metres;
- increase service life by more than 40% compared with the current average drilled distance of approximately 900 metres;
- submit one research report;
- file two invention patent applications; and
- publish two SCI-indexed journal papers.

Funding ceiling: RMB 300,000
Technical contact: Mr/Ms Wan, +86 156 9612 3512

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7. Formation Characteristics of Toxic Gaseous Products from Gas and Coal-Dust Explosions in the Presence of Explosion Suppressants

Research Scope

This project addresses the limited understanding of the types and concentration changes of toxic gaseous products generated following gas or coal-dust explosions in the presence of typical explosion suppressants.

The project will:

- investigate the reaction pathways associated with toxic gaseous products;
- establish oxidation kinetic models for different reaction systems;
- reveal the formation mechanisms of toxic gaseous products;
- experimentally investigate the composition and concentration changes of toxic gaseous products following explosions under different gas concentrations, coal-dust quantities, coal-dust distribution lengths and suppressant dosages;
- determine how explosion suppressants affect the types and concentrations of toxic products;
- quantify the relationships among post-explosion toxic-gas concentrations, gas and coal-dust quantities, and suppressant dosages; and
- establish a multicomponent gas-generation prediction model.

Expected Outputs and Performance Indicators

The project is expected to:

- reveal the mechanisms governing toxic-gas formation in the presence of explosion suppressants;
- clarify the relationships between toxic-gas concentrations and the quantities of gas, coal dust and explosion suppressants involved;
- establish a prediction model for multicomponent gas generation;
- submit reaction-mechanism files and experimental datasets;
- submit one research report;
- publish two SCI-indexed papers; and
- file one invention patent application.

Funding ceiling: RMB 200,000
Technical contact: Mr/Ms Huang, +86 138 8332 9680

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8. High-Resolution Imaging of Transient Airflow Fields in Confined Underground Spaces

Research Scope

Airflow distribution in underground roadways directly affects gas dispersion, dust transport and ventilation efficiency. Conventional point-based airflow measurements cannot adequately represent complex three-dimensional flow-field structures.

This project will:

- investigate the effects of dust, water mist, field of view and measurement distance on the imaging performance of particle image velocimetry systems;
- evaluate measurement range, measurement accuracy and spatial resolution under different underground conditions;
- address the environmental adaptability and operational safety challenges associated with underground application of particle image velocimetry;
- develop a particle image velocimetry testing system suitable for the specific environmental conditions of coal mine roadways; and
- provide data support for mine ventilation optimisation, disaster warning and intelligent ventilation control.

Expected Outputs and Performance Indicators

The project is expected to:

- propose a feasible low-power particle image velocimetry solution for high-dust underground conditions;
- establish a particle image velocimetry testing system suitable for coal mine roadways;
- achieve high-accuracy, non-contact, full-field measurement of transient airflow fields;
- achieve a measurement range of 0–15 m/s;
- achieve a measurement error of no more than 1% of full scale;
- achieve a full-field visualisation resolution of no more than 200 mm;
- achieve a field of view of no less than 20 metres;
- submit one research report;
- have one invention patent application formally accepted; and
- publish one SCI-indexed journal paper.

Funding ceiling: RMB 200,000
Technical contact: Mr/Ms Li, +86 138 8367 2800

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9. Coal Mine Gas-Risk Causal Dataset and Classification Benchmark Model

Research Scope

This project addresses the difficulty of identifying nonlinear abnormal gas emissions, the shortage of labelled samples for causal analysis and the lack of consistent classification and evaluation methods.

The project will:

- establish an integrated spatiotemporal and causal labelling standard and quality-control method for gas time-series monitoring data;
- construct a labelled gas-risk causal dataset covering representative gas-geological conditions and production processes;
- establish a benchmark classification and identification model based on similarity evaluation of variable-length time-series data; and
- enable classification and accurate evaluation of typical abnormalities associated with geological structures, stress concentration, coal-seam

thickening, accelerated mining or development, and gas or coal ejection during drilling.

Expected Outputs and Performance Indicators

The project is expected to:

- establish one labelling standard and dataset for working-face gas-risk causes;
- include at least 100 months of valid operating data;
- include at least two months of valid operating data for each working face;
- include at least 500 abnormal samples;
- establish one benchmark classification and identification model for the gas-risk dataset;
- achieve a precision of at least 80% under the condition that abnormal-sample recall is at least 90%;
- submit one gas-risk causal labelled dataset;
- submit the source code for one classification benchmark model; and
- publish one EI-indexed journal paper.

Funding ceiling: RMB 250,000
Technical contact: Mr/Ms He, +86 183 2343 2139

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10. Intelligent Data Processing and AI-Based Identification of Typical Anomalies in Borehole Radar Data

Research Scope

This project addresses the high dependence of borehole radar interpretation on manual analysis and the limited generalisation capability of models caused by insufficient real-world samples of representative anomalies. The project also covers ground-penetrating radar used for advance geological detection at roadway or tunnel faces.

The project will:

- select highly adaptable signal-processing algorithms and establish a customised, efficient data-processing workflow;
- establish forward-simulation models to generate pre-training datasets and augment available data;

- develop a transfer-learning mechanism combining simulation-based pre-training with fine-tuning using measured data;
- establish an AI model for identifying representative anomalies and improve robustness under complex operating conditions;
- develop standard application programming interfaces;
- package the core algorithms and AI inference engine as independent modules; and
- develop modular intelligent interpretation software compatible with the Windows operating system and capable of integration with existing systems.

Expected Outputs and Performance Indicators

The project is expected to:

- develop one intelligent data-processing software package for borehole radar and, where applicable, roadway-face advance-detection radar;
- submit one set of supporting software technical documentation;
- ensure compatibility with Windows;
- provide dedicated data-processing workflows for specific geological or mining scenarios;
- provide standard APIs for integration and use by third-party software;
- enable automatic annotation and identification of representative anomalies;
- achieve an AI identification accuracy greater than 80% on the test dataset for the defined representative anomalies;
- publish one SCI-indexed paper; and
- obtain one software copyright registration.

Funding ceiling: RMB 300,000
Technical contact: Mr/Ms Hu, +86 188 8330 9680

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11. Key-Frequency Noise Reduction for Mine Exhaust-Type Contra-Rotating Axial-Flow Fans

Research Scope

This project addresses the complex noise-generation mechanisms, diverse spectral characteristics and lack of targeted noise-control measures for mine exhaust-type

contra-rotating axial-flow fans operating under complex counter-rotating flow fields and inflow disturbances.

The project will:

- analyse unsteady load responses on rotating and stationary solid surfaces generated by complex flows;
- investigate the modulation mechanisms of these responses on fan noise;
- study the modal excitation and propagation characteristics of fan noise within ducts;
- establish prediction models for fan-noise generation and propagation;
- develop a parametric design method for noise-reduction structures targeting key-frequency noise sources; and
- propose a key-frequency noise-suppression solution for exhaust-type contra-rotating axial-flow fans used in mine wet dust collectors.

Expected Outputs and Performance Indicators

The project is expected to:

- clarify the modal characteristics of noise generated by mine exhaust-type contra-rotating axial-flow fans;
- establish prediction models for fan-noise generation and propagation;
- achieve a noise-frequency prediction error of no more than 1%;
- achieve a pressure-mode amplitude prediction error of no more than 3 dB;
- propose a key-frequency fan-noise reduction solution;
- reduce the sound pressure level of the three most significant tonal interference peaks in the fan-noise spectrum by at least 15 dB;
- maintain the main external dimensions of the fan;
- limit the reduction in total-pressure efficiency to no more than 5%;
- submit one research report;
- publish two SCI-indexed papers; and
- file one invention patent application.

Funding ceiling: RMB 200,000
Technical contact: Mr/Ms Lu, +86 176 2300 5161

12. Coupled Mechanisms of Coal Pore–Fracture Evolution and Water-Injection Wetting in the Pressure-Relief Zone of Longwall Faces

Research Scope

This project addresses the complex operating conditions in pressure-relief zones where shallow-hole water injection is undertaken, the lack of relevant theoretical understanding, and the reliance on experience in selecting injection-process parameters.

The project will investigate:

- stress distribution and influencing factors in the pressure-relief zone of a longwall face;
- the effects of mining-induced disturbance on the evolution of coal pore and fracture structures;
- the effects of water injection on coal pore and fracture structures;
- water-injection penetration and wetting in fractured coal within the pressure-relief zone; and
- the coupled mechanisms between coal pore–fracture structures and water-injection wetting.

The research will provide a theoretical basis for selecting parameters for shallow-hole water injection and improving dust suppression at the source.

Expected Outputs and Performance Indicators

The project is expected to:

- establish one theoretical model for water penetration and wetting in the pressure-relief zone of a longwall face;
- reveal the coupled mechanisms between pore–fracture evolution and water-injection wetting;
- provide scientifically sound theoretical guidance for selecting shallow-hole water-injection parameters and achieving optimum dust-suppression performance;
- submit one research report;
- publish at least two non-open-access SCI-indexed papers; and
- file one invention patent application.

Funding ceiling: RMB 200,000
Technical contact: Mr/Ms Ma, +86 134 3605 0599

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13. Hydrothermal-Coupled Numerical Simulation of High-Temperature, Water-Rich Aquifers in Deep Mines

Research Scope

This project addresses the combined water and heat hazards caused by water seepage or inflow from sandstone aquifers above coal seams in deep mines.

The project will:

- establish mathematical models for groundwater-flow and thermal fields;
- apply hydrothermal-coupled numerical simulation methods;
- represent the porous-medium structure of water-rich and heat-bearing sandstone pore–fracture aquifers;
- establish a coupled groundwater-flow and thermal-field numerical model;
- assess the effects of roof-aquifer seepage or inflow on temperatures within mining and development spaces;
- investigate the effects of branched, directionally drilled long-hole drainage systems on aquifer groundwater-flow and thermal fields;
- assess the effect of aquifer drainage on underground workplace temperatures; and
- develop an optimised drainage design for aquifers above development roadways with underground temperature control as the principal objective.

Expected Outputs and Performance Indicators

The project is expected to:

- establish analytical mathematical models for groundwater-flow and thermal fields within sandstone aquifers;
- develop a numerical modelling method for temperature changes in mining and development spaces caused by water seepage or inflow;
- reveal the effects of aquifer drainage on groundwater-flow fields and roadway temperature fields;
- ensure that the discrete-element scale of the numerical model is no greater than 1/150 of the overall model dimensions;

- submit one research report;
- publish two SCI- or EI-indexed papers; and
- have one invention patent application formally accepted.

Funding ceiling: RMB 200,000
Technical contact: Mr/Ms Ding, +86 188 0123 7271

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14. Spatiotemporal Prediction and Risk Assessment of Bedding-Separation Water Inrush in Western Mining Areas

Research Scope

This project addresses the prevention and control of water hazards associated with bedding separation in western mining areas.

Using discrete-element numerical analysis and physical simulation experiments, the project will:

- investigate the effects of mining-induced fracture development, overburden displacement and other factors on the formation, deformation, failure and water breakthrough of bedding separations;
- establish mechanical models for the dynamic evolution of bedding separations under representative strata combinations;
- establish analytical formulas for the formation cycle, spatial location and dimensions of bedding separations, together with failure criteria;
- analyse relationships among bedding-separation water inrush, water pressure, mined-out space and the mechanical properties of aquicludes;
- establish an indicator system for identifying bedding-separation water-inrush hazards; and
- develop a comprehensive risk-assessment method.

Expected Outputs and Performance Indicators

The project is expected to:

- complete physical simulation experiments of bedding-separation water-inrush processes at a geometric similarity ratio of no less than 1:300;
- ensure that the discrete-element scale of numerical models is no greater than 1/150 of the overall model dimensions;

- develop theoretical formulas for bedding-separation formation cycles, spatial locations and dimensions that incorporate water pressure, surrounding-rock stress and rock-mechanical parameters;
- propose a spatiotemporal prediction method for bedding-separation water-inrush hazards;
- submit one research report;
- publish two SCI- or EI-indexed papers; and
- file one invention patent application.

Funding ceiling: RMB 200,000
Technical contact: Mr/Ms Fan, +86 131 9334 9338

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15. Efficient Rock-Breaking for Directional Water-Detection and Drainage Drilling in Hard Rock in Kilometre-Deep Mines

Research Scope

This project addresses efficient rock breaking during directional drilling through hard rock, with a Protodyakonov strength coefficient of f = 10–15, under high-stress conditions in kilometre-deep mines.

Based on deep-mine directional water-detection and drainage requirements, the project will:

- apply classical rock-breaking theories to investigate the behaviour of polycrystalline diamond compact drill bits during near-horizontal directional drilling in hard rock;
- conduct micro-drilling experiments under static rotary loading and dynamic impact-rotary loading;
- investigate the effects of loading type, weight on bit, rotational speed and other parameters on rock-breaking efficiency and the service life of PDC cutters;
- determine the maximum laboratory mechanical penetration-rate range of PDC drill bits in hard rock;
- propose concepts for a new drill bit suitable for underground directional drilling in hard rock; and
- develop an efficient rock-breaking method for near-horizontal boreholes under low weight-on-bit conditions.

Expected Outputs and Performance Indicators

The project is expected to:

- reveal the rock-breaking characteristics of PDC drill bits during near-horizontal directional drilling in deep hard-rock formations;
- use no fewer than three types of hard-rock specimens with different strength coefficients in micro-drilling experiments;
- ensure that the tested ranges of weight on bit, rotational speed, impact load and other experimental parameters vary by a factor of no less than two;
- develop a new high-efficiency rock-breaking method for near-horizontal boreholes under low weight-on-bit conditions;
- submit one research report;
- publish two SCI- or EI-indexed papers; and
- file one invention patent application.

Funding ceiling: RMB 200,000
Technical contact: Mr/Ms Liu, +86 181 9286 5043

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16. Formation Theory and Prediction of Water–Sand Inrush Hazards in Deep-Buried Weakly Cemented Strata

Research Scope

This project addresses water and sand inrush hazards originating from weakly cemented strata above coal seams in deep-buried mining areas in central and western China.

Using physical simulation experiments and particle-flow numerical analysis, the project will:

- investigate the effects of mining-induced overburden movement and hydraulic gradients on the mobilisation of mud and sand within weakly cemented strata;
- calculate actual hydraulic gradients using complete-well flow theory for unsteady flow;
- establish a water-and-sand-conducting mechanical model incorporating stress distribution and hydraulic gradients;
- establish a formula for calculating the critical hydraulic head at which water and sand inrush occurs;

- reveal the mechanisms of water and sand inrush under the combined effects of overburden movement, hydraulic gradients and other factors; and
- propose a risk-assessment and prediction method.

Expected Outputs and Performance Indicators

The project is expected to:

- complete physical simulation experiments of water and sand inrush from deep-buried weakly cemented strata at a similarity ratio of no less than 1:300;
- establish a formation theory incorporating mining activities, hydraulic gradients and sand-body characteristics;
- propose a risk-assessment and prediction method for water and sand inrush;
- submit one research report;
- publish two SCI- or EI-indexed papers; and
- file one invention patent application.

Funding ceiling: RMB 200,000
Technical contact: Mr/Ms Xing, +86 158 2926 0602

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17. Synergistic Oxygen-Isolation and Temperature-Control Mechanisms and Performance Regulation of Bio-Based Gel Foams for Coal-Spontaneous-Combustion Prevention

Research Scope

This project addresses coal spontaneous combustion in complex environments including port coal stockpiles, open railway wagons and underground goaf areas.

The project will develop an environmentally friendly, flame-retardant bio-based double-network gel foam with:

- high fluidity;
- controllable gelation time;
- rapid penetration into coal masses;
- close and effective coverage of coal surfaces;
- effective isolation of coal from oxygen;
- the ability to interrupt oxidation and spontaneous-combustion chain reactions;

- stable three-dimensional structure and sealing performance at elevated temperatures;
- strong high-temperature thermal stability and flame-retardant properties; and
- good environmental performance without secondary pollution.

Expected Outputs and Performance Indicators

The project is expected to develop an environmentally friendly, flame-retardant bio-based double-network gel foam suitable for preventing spontaneous combustion in port coal stockpiles and other complex environments.

The material must meet the following indicators:

- initial gelation time of at least 5 minutes;
- delayed gelation time of at least 40 minutes;
- half-life of at least 30 days under high-temperature, high-wind and long-term storage conditions;
- carbon-monoxide inhibition rate of at least 70%;
- water-retention rate of at least 85% after 12 hours at 80°C;
- pH between 6.5 and 7.5;
- suspended-solids content of no more than 110 mg/L;
- total dissolved solids of no more than 110 ppm;
- submission of one research report;
- publication of two SCI- or EI-indexed papers; and
- filing of one invention patent application.

Funding ceiling: RMB 200,000
Technical contact: Mr/Ms Wang, +86 150 4120 7897

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18. Regional-Scale Detection and Identification of Coal Fires Using Long-Term Remote-Sensing Time Series

Research Scope

This project addresses the applicability of long-term remote-sensing time-series methods for detecting and identifying coal fires at a regional scale.

The project will:

- analyse the relationship between land-cover types and average land-surface temperature under different survey-area scales;
- investigate the effects of survey-area size and land-cover type on long-term time-series identification of coal fires;
- identify the key land-cover types affecting identification accuracy;
- establish relationships between coal-fire identification thresholds and land-cover types;
- determine an optimum survey-area size; and
- improve the accuracy and efficiency of long-term remote-sensing detection and identification of coal fires.

Expected Outputs and Performance Indicators

The project is expected to:

- propose a regional-scale coal-fire detection and identification method based on long-term remote-sensing time series;
- use remote-sensing imagery covering a period of at least 10 years;
- use imagery with a temporal resolution of at least once per month;
- validate the method in at least two representative coal-fire areas with different land-cover characteristics;
- achieve an identification accuracy greater than 70%;
- submit one research report;
- publish two SCI- or EI-indexed papers; and
- file one invention patent application.

Funding ceiling: RMB 200,000
Technical contact: Mr/Ms Wang, +86 150 4120 7897

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19. Development of a Natural Saponin-Based Composite Coal-Oxidation Inhibitor

Research Scope

This project addresses the relatively low inhibition efficiency, limited penetration and insufficient long-term effectiveness of conventional inhibitors used to prevent spontaneous combustion in coal mine goaf areas.

The project will develop a new composite inhibitor using natural saponin as the principal active ingredient. The material should be:

- environmentally friendly and biodegradable;
- highly effective in inhibiting coal oxidation;
- highly penetrative;
- thermally stable; and
- strongly adhesive to coal surfaces.

The project will select three to five representative coals classified as liable or highly liable to spontaneous combustion and will:

- conduct Fourier-transform infrared spectroscopy;
- conduct X-ray photoelectron spectroscopy;
- conduct programmed-temperature experiments;
- identify the active functional groups and spontaneous-combustion characteristics of the coal samples;
- introduce synergistic components; and
- establish a multi-mechanism inhibition system capable of providing long-term flame-retardant performance for coals of different ranks.

Expected Outputs and Performance Indicators

The project is expected to develop a natural saponin-based composite inhibitor suitable for spontaneous-combustion prevention in coal mine goaf areas.

The inhibitor must achieve:

- a penetration depth of at least 30 cm within a coal pile;
- an inhibition rate of at least 75%;
- an effective flame-retardant period of no less than 60 days after application;
- an improvement of at least 30% in the spontaneous-combustion tendency index determined using the oxidation-kinetics method;
- submission of one research report;
- publication of two SCI- or EI-indexed papers; and
- filing of one invention patent application.

Funding ceiling: RMB 200,000
Technical contact: Mr/Ms Wang, +86 150 4120 7897

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20. Underground Carbon-Monoxide Abatement Using Thin-Walled Corrugated Fibre Catalytic Materials

Research Scope

This project addresses carbon monoxide and associated gases released during coal oxidation, mining-explosive detonation and diesel combustion by explosion-protected underground vehicles.

The project will develop a new thin-walled corrugated fibre catalytic material with:

- high wear resistance;
- high air permeability;
- efficient filtration and catalytic performance; and
- the capacity for repeated regeneration and reuse.

The project will investigate the effects of:

- corrugated geometry;
- fibre-surface modification processes;
- active-component formulations;
- temperature;
- humidity;
- airflow rate; and
- air velocity

on carbon-monoxide abatement performance.

It will also develop a process for efficient recycling and reuse of the abatement material and establish a high-efficiency regeneration and reuse system.

Expected Outputs and Performance Indicators

The project is expected to develop a thin-walled corrugated fibre catalytic material suitable for low-temperature and high-humidity underground environments.

The project must:

- identify the optimum combination of corrugation height, corrugation spacing, wall thickness, fibre-surface modification method and active components;
- achieve an air permeability of at least 800 L/(m^2·s) at a pressure differential of 200 Pa;
- achieve a filtration efficiency of at least 90% for coal-dust particles with a diameter of at least 1 μm;
- achieve a combined removal rate of at least 85% for representative underground harmful gases such as CO and NO_x under low-temperature and high-humidity conditions;
- achieve a single-use duration of at least one hour;
- achieve catalytic-activity recovery of at least 90% following regeneration;
- enable at least five reuse cycles;
- submit one research report;
- publish two SCI- or EI-indexed papers; and
- file one invention patent application.

Funding ceiling: RMB 200,000
Technical contact: Mr/Ms Wang, +86 150 4120 7897

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21. Nano-Composite Phase-Change Cooling Protective Clothing and Thermal–Moisture Comfort

Research Scope

This project addresses the urgent need for personal thermal protection in mines with high surrounding-rock temperatures.

The project will develop:

- a cold-energy-storage nano-composite phase-change material; and
- personal thermal-protection equipment incorporating the material.

The research will focus on coordinated control of energy storage, thermal conductivity and shape stability in multicomponent composite systems.

The project will:

- select an appropriate matrix material;
- incorporate highly thermally conductive nanofillers and polymer frameworks;

- develop a composite phase-change material with high energy-storage density, high thermal conductivity and strong cycling stability;
- develop flame-retardant, pressure-resistant and leakage-resistant encapsulation materials and processes;
- select inherently flame-retardant and antistatic fabrics;
- design personal thermal-protection clothing;
- investigate thermal and moisture comfort; and
- propose optimised clothing designs for production, auxiliary and other underground roles.

Expected Outputs and Performance Indicators

The project is expected to:

- develop a cold-energy-storage nano-composite phase-change material and encapsulation process;
- achieve a phase-change temperature between 20°C and 22°C;
- achieve a charging or cold-storage preparation time of no more than two hours at room temperature;
- achieve a cooling duration of at least four hours at an ambient temperature of 35°C and relative humidity of at least 90%;
- ensure that an encapsulated phase-change pack withstands a static load of at least 490 N;
- allow at least 100 reuse cycles;
- ensure no leakage after storage for 180 days;
- develop two ergonomically designed cooling-garment styles;
- submit one research report;
- publish two SCI- or EI-indexed papers; and
- file one invention patent application.

Funding ceiling: RMB 200,000
Technical contact: Mr/Ms Wang, +86 150 4120 7897

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22. Strata Fracture and Movement Following Regional Hydraulic Fracturing

Research Scope

Regional hydraulic fracturing is commonly used in coal mines to weaken roof strata. However, the fracture and movement behaviour of hydraulically weakened strata and the corresponding mining responses are not yet fully understood.

The project will:

- establish mechanical models of strata fracture and movement before and after regional hydraulic fracturing;
- analyse the evolution of roof fracture and movement for different fracturing horizons;
- investigate relationships among surface subsidence, strata movement and working-face ground-pressure behaviour; and
- use field monitoring to reveal and validate strata fracture and movement patterns.

Expected Outputs and Performance Indicators

The project is expected to:

- establish mechanical models for roof-strata fracture and movement before and after regional hydraulic fracturing;
- validate the evolution of strata fracture and movement through field measurements;
- demonstrate the applicability of the identified movement patterns at no fewer than two mines;
- submit one research report;
- publish two SCI- or EI-indexed journal papers; and
- file one invention patent application.

Funding ceiling: RMB 150,000
Technical contact: Mr/Ms Zhang, +86 151 0100 5517

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23. Mine-Seismicity Mechanisms Induced by Thick, Hard Roof Failure and Seismic-Mitigation Technology

Research Scope

This project addresses key challenges in managing mine seismicity in Chinese coal mines, including:

- insufficient understanding of hazard-development mechanisms;
- inaccurate source location;
- difficulty identifying critical strata; and
- limited effectiveness of current mine-seismicity control measures.

Using theoretical analysis, numerical simulation and field trials, the project will:

- establish refined structural-mechanical models for roof failure and instability at different stratigraphic levels;
- reveal the fracture sequence, structural evolution and dynamic energy processes of overlying strata under the combined action of multiple key strata;
- use rock mechanics, structural mechanics and energy theory to quantify the accumulation and release of energy from elastic storage through plastic deformation to final fracture and instability;
- clarify the fundamental mechanical nature of mine-seismicity development;
- establish scientific relationships between macroscopic mine-seismic phenomena, such as strong vibration and support damage, and microscopic fracture mechanisms;
- use statistical and mechanical analyses to identify and quantify the principal controlling factors;
- evaluate the contributions and coupled effects of mining parameters, including mining intensity, mining rate and panel layout;
- evaluate the effects of key-strata lithological combinations and spatial structures;
- evaluate geological-structure activation conditions;
- evaluate the evolution of original and mining-induced stress fields;
- develop targeted active pressure-relief and seismic-mitigation technologies; and
- conduct industrial-scale trials at representative working faces with mine-seismicity risks.

Expected Outputs and Performance Indicators

The project is expected to:

- reveal the mechanisms through which thick, hard roof failure induces mine seismicity;

- develop a pressure-relief and seismic-mitigation technology;
- submit one research report;
- publish two SCI- or EI-indexed papers; and
- file two invention patent applications.

Funding ceiling: RMB 200,000
Technical contact: Mr/Ms Zhao, +86 135 2148 7797

II. Eligibility Requirements

1. The project applicant must be external to both the Laboratory and its host institution.
2. In principle, an applicant must:
    - hold a doctoral degree; or
    - hold a professional or technical position at associate-professor, associate-researcher or equivalent level or above; and
    - be under 45 years of age.

An applicant who does not meet the qualification or degree requirements must obtain recommendations from two experts holding senior professional or technical positions.

3. Applicants with serious records of dishonesty, breaches of research integrity, or violations of research ethics are not eligible to apply.
4. The applicant's employing institution must:
    - have independent legal-person status; and
    - have sound research-project management capabilities.
5. The applicant's employing institution must:
    - review the applicant's capability and professional standing;
    - review the proposed research;
    - provide a formal review opinion;
    - undertake to provide the applicant with the necessary time and conditions to complete the project; and
    - affix its official institutional seal to the application.

III. Additional Information

1. Applicants must download and complete the **Open Fund Project Application Form of the State Key Laboratory of Coal Mine Disaster Prevention and Control**, provided as Attachment 1.

After the applicant's employing institution has provided its formal opinion and affixed its official seal, one hard copy of the application must be posted to the Laboratory.

Applicants must also email the following electronic files to **sklcmdpc@163.com**:

- an editable Microsoft Word version; and

- a signed and stamped PDF version.

The email subject line and application filenames must use the following format:

Guideline Number + Project Title + Applicant Name + Applicant Institution

2. The application deadline is **25 July 2026**.
3. Applications will be reviewed by experts organised by the Laboratory, and projects will be selected on a competitive basis.
4. The project period will commence on the date on which the project task agreement is signed and should, in principle, not exceed two years.
5. Intellectual property generated through a funded project, including journal papers, monographs, patents and software copyrights, will in principle be owned by the Laboratory's host institution.

Inventors and their employing institutions will retain the right to use the intellectual property for scientific research and teaching activities.

6. For all projects funded by the Laboratory, publicly released research outputs must comply strictly with the requirements specified in the Open Fund Project agreement or project task agreement.

The **State Key Laboratory of Coal Mine Disaster Prevention and Control** must be listed as the first completing institution.

The following funding acknowledgement must also be included:

Chinese acknowledgement:

得到煤矿灾害防控全国重点实验室开放基金（课题编号：******）资助

Required English acknowledgement:

"Supported by the Open Funding of StateKey Laboratory of Coal Mine Disaster Prevention and Control (Grant No. ******)."

Research outputs that do not include the required institutional affiliation and funding acknowledgement will not be accepted as project outputs for final project assessment.

7. Each applicant may submit only one application.
8. Enquiries regarding the technical scope of an individual project should be directed to the technical contact listed under that project.

IV. General Contact Details

Contact person: Moran Zhu
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Email: sklcmdpc@163.com
Address: No. 55, Shangqiao Sancun, Shapingba District, Chongqing, China
Postcode: 400037

Attachment

Attachment 1: Open Fund Project Application Form

Please download the application form from the attachment to this article.