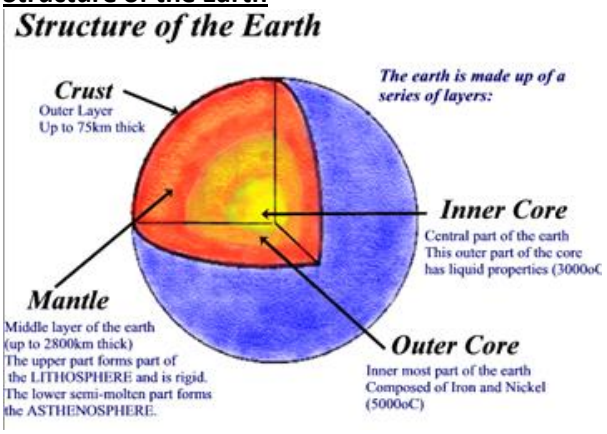
Plate tectonics

2022年11月2日 23:40

Keywords

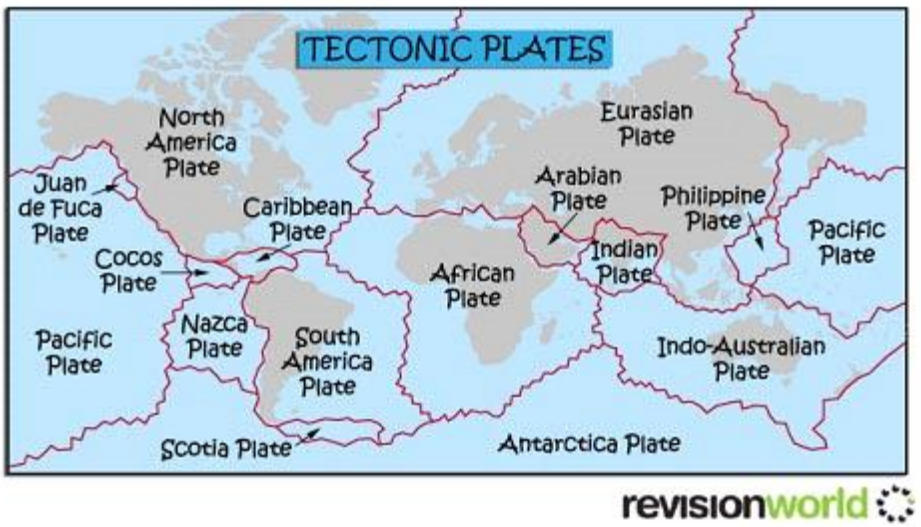
- https://quizlet.com/cn/742119072/flash-cards/

Structure of the Earth



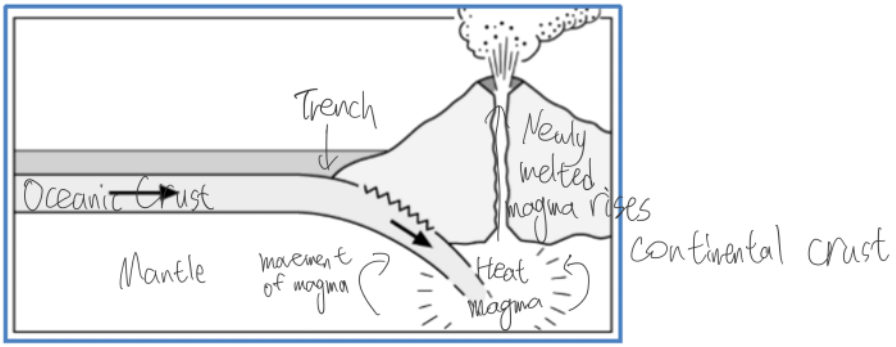
- Crust
  - Solid rock, thin
  - Oceanic crust: made of basalt, very young, thinner (5-10km), denser
  - Continental crust: made of granite, older, thicker (up to 70km), less dense
- Mantle
  - Very thick - 2900 km
  - Molten rock - 1000°C magma
- Core
  - Made of metals such as iron /nickel
  - Extremely hot (5000°C)

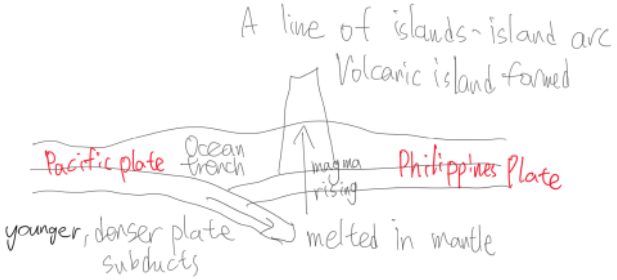
Theory of plate tectonics

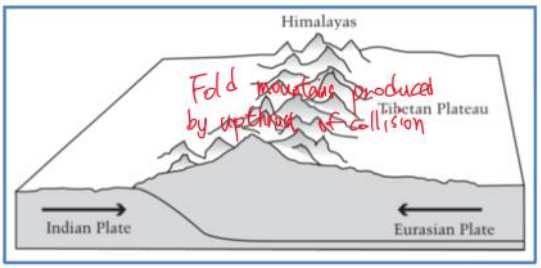


- 7 major plates and other smaller plates
- Convection currents
  - In the mantle
  - The heat from the radioactive materials in the core (5,000°C) heating up the magma in the lower mantle
  - The hot magma is less dense + rises where it cools and then sinks causing a circular movement of magma within the mantle.
  - Causes the plate to move slowly

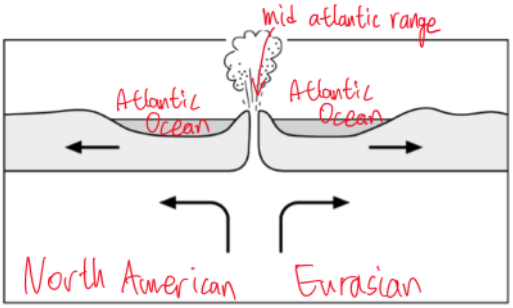
Plate boundaries

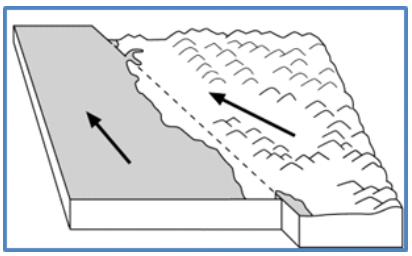
- Destructive (convergent) - O+C
  - Heavier oceanic crust moves towards lighter continental crust
  - The denser oceanic crust subducts under the lighter continental crust at the subduction zone
  - The oceanic crust melts to form magma due to heat and friction in mantle
  - The newly formed magma is less dense then magma in the mantle and rises to the surface in cracks in the continental crust
  - Lava solidifies to form volcanoes
  - The continental crust crumples to form fold mountains
  - A deep ocean trench forms where the two plates meet
  - Both volcanoes and earthquakes happen on these boundaries and they are powerful
  - The earthquakes focus are located where the two plates meet and have any focus depth
  - 

- Destructive - O+O
  - Similar to O+C
  - No fold mountains since there is no continental crust
  - Island arc formed in the mid ocean
  - 

- Collision
  - Two continental plates move towards each other
  - The continental plates fold/crumple upwards to form fold mountains e.g. Himalayas
  - There are powerful earthquakes
  - There are no volcanoes because there is no rising magma.
  - 

- Constructive (divergent)
  - Two plates move away from each other
  - A gap appears between the plates which fills with magma from the mantle
  - The magma solidifies to form volcanoes (new crust)
  - Under the ocean: mid ocean ridge
  - Land: rift valley e.g. Great African Rift Valley
  - Gentle volcanoes and earthquakes form on these boundaries
  - 

- 

- Conservative
  - Two plates slide past each other
  - The plates become locked together due to friction and pressure builds up
  - When the pressure is too strong, the plates tear apart along a fault line e.g. San Andreas Fault
  - The pressure is released as seismic energy and produces powerful earthquakes
  - There are no volcanoes because there is no rising magma
  - North American + Caribbean
  - 

Fold mountains

- Destructive / collision plate boundary
- Needs a continental plate
- The sedimentary rocks that have built up on the plate are forced upward and folded/crumpled to form fold mountains.

Distribution

- Fold mountains
  - Unevenly
  - Along plate boundaries with a continental crust
  - Found at destructive plate and collision plate boundaries
  - Northeast Siberia - not along the plate boundaries
- Volcanoes
  - Unevenly
  - In narrow bands, on plate boundaries (except collision / conservative)
  - Mostly around Pacific Ring of Fire on the boundary of the Pacific Plate
  - Along constructive plate boundaries e.g. mid Atlantic Ridge
  - At hot spots in the centre of plates e.g. Hawaii
- Earthquakes
  - Unevenly
  - In narrow bands, on all types of plate boundaries
  - Around Pacific Ring of Fire on the boundary of the Pacific Plate
  - In similar pattern to volcanoes
  - Exception: China (not along plate boundaries)

Volcanoes

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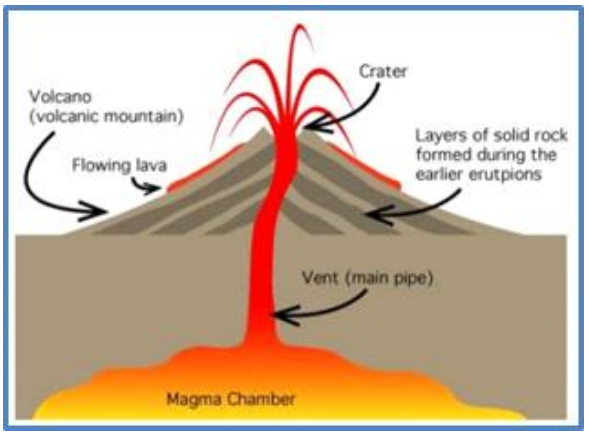
Keywords

- https://quizlet.com/cn/742120325/flash-cards/



Formations at hotspots

- The magma comes directly from the mantle
- There is a hot rising plume of magma in the mantle and the oceanic crust is thin
- The magma can force its way to the surface and form volcanoes e.g. Hawaiian Islands

Secondary cones / Parasitic cones

- In stratovolcanoes
- These are created when the main vent is blocked by solidified magma.
- The molten magma finds another line of weakness to the surface on the sides of the main volcano.
- The lava solidifies on the surface forming a small cone

Hazards

- **lava flows**: fast flowing rivers of molten rock which flow down volcano sides
- **ash clouds**: ash is **ejected up** into the atmosphere and then deposited in layers around the volcano. It covers + kills crops and sometimes it is so deep it buries buildings or the weight of ash collapses them
- **volcanic bombs**: partly solidified blocks of lava which are ejected from the crater + fall on the volcano sides
- **lahars**: melted snow from top of high volcanoes mix with ash + run down the volcano sides as fast flowing mudflows
- **pyroclastic flows**: clouds of extremely hot, poisonous gases mixed with ash **flow down** the volcano sides at speed up to 200km per hour
- **tsunamis:** when a volcano side collapses into the sea during an eruption, sea water is displaced and forms large waves called tsunamis

Types of volcanoes

- Stratovolcano
  - Destructive plate boundaries
  - Steeper slopes and narrower base
  - Viscous lava not flowing far from the vent
  - Solidifies quickly, forming layers of ash and lava
  - Thicker lava because it is cooler and is from melted plate
  - Magma can solidify in the vent and the volcano becomes dormant
  - More explosive eruptions but less frequently
  - Secondary / parasitic cones
  - Plates may be stuck: no eruption because no melted plate
- Shield volcano

- Large, wider volcanoes / formed by lava only
- Gentler slopes
- Runny lava flows down the slope, away from the summit vent before it solidifies slowly
- Runny lava because it is hot magma from the mantle
- Constructive plate boundaires or hot spots
- More frequent eruptions - plates moving away, lava coming out frequently

States of volcanoes

- Active volcano: has recently erupted + likely to erupt again
- Dormant volcano: hasn't erupted for over 100 years
- Extinct volcano: has finished erupting + the magma chamber has cooled down, hasn't erupted for 2000 years

Eruptions

- The magma chamber fills up with magma
- Heat and pressure build up
- Magma is released and flows out of the volcano in lava

Impacts

- People evacuated
  - People displaced because homes destroyed
- Land covered in ash which destroys crops
  - Food insecurity
  - Deaths from food shortage
- Contaminated water supplies by ash or pipes destroyed by lava/pyroclastic flows
  - Deaths from unclean water
  - Diseases spread
- Deaths & injuries from volcanic ejecta
- Buildings destroyed and roads blocked by ash & pyroclastic flow
  - Loss of earnings because business closed
  - High cost to rebuild homes, schools, businesses & clear road
  - Emergency aid workers cannot access
- Ash cloud blocks out the sunlight + causes darkness
  - Air space to be closed because jet airplanes cannot fly through the ash safely
  - Disrupts plant photosynthesis

Reasons for not leaving

- The layer of ash from the eruption can fertilise the soil
  - The lower slopes of the volcano can be used for intensive farming
  - High crop yields
- Cheap and clean geothermal energy
- Mining sulphur, diamonds and golds
- Tourism jobs e.g. as guides or working in hotels.
- Scientific study: scientists studying plate tectonics and developing prediction methods locate near active volcanoes
- No choice or because of family traditions
  - Their families have lived there for generations
  - They want to live near their family
  - Can only make livings in the area
    - e.g. on their family farm
  - They can not afford to move

Reducing Impacts

- Predicting eruptions
  - Seismometers: measure increasing number of earthquakes caused by the magma pushing up under the volcano
  - Tilt meters: measure change in the volcano's shape as the magma causes the surface to bulge

outwards
    - Thermometers: measure the increase in ground temperature as the magma moves towards the surface
    - Gas sensors: measure the increase in release of gases from the volcano
- Houses + schools/hospitals are built avoiding areas at risk from the eruption using risk maps
- Emergency services are trained
    - Using planned evacuation routes
    - Setting up evacuation
    - Emergency medical camps
- People are educated
    - How to evacuate safely
    - Leaving for temporary shelters
    - How to make an emergency survival kit
- Houses built to resist ash deposit
- Cool lava using sea water

Earthquakes

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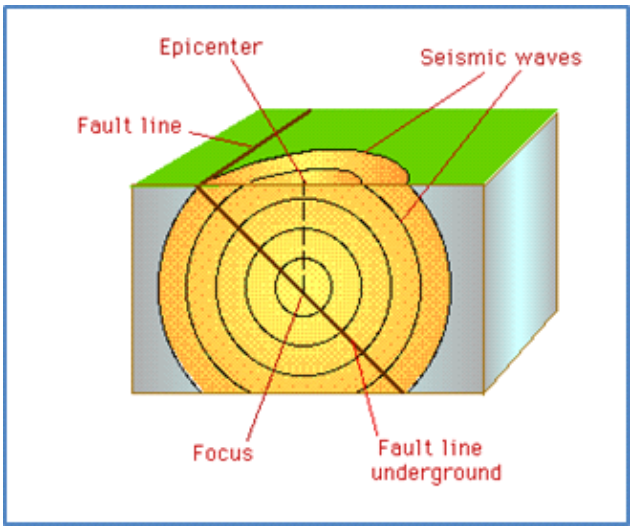
Keywords

- https://quizlet.com/cn/742119831/flash-cards/



Causes

- Destructive: pressure builds up when one plate gets stuck as it subducts down into the mantle
- Constructive: pressure builds up along cracks within the plates as they move apart
- Conservative: pressure builds up when the plates are moving past each other + get stuck
- When the plates eventually move, there is a sudden release of pressure
- Seismic energy is released, causing seismic waves to travel through the crust to the surface → ground shaking

Earthquake scales

- Moment magnitude scale & Richter scale
  - Logarithmic - 10 times greater than the value below
  - Measure seismic energy carried by seismic wave
  - Magnitude is measured using a seismometer
- Mercalli Scale
  - This measures the impacts of an earthquake.
  - These are measured by asking eye witnesses for observation of what happened
  - The scale is from 1-12

Hazards

Landslides	Earth shakes steep slopes causing loose rocks to slide down the slopes
Tsunamis	Some earthquakes take place under the ocean. The shockwaves cause the ocean floor to rise, displacing water above, causing waves
Ground shaking	Seismic energy released sending seismic waves through the crust
Buildings collapse	Strength of buildings weakened by the earth shaking
Fires	Electricity wires are broken and cause sparks
Liquefaction	Saturated soil temporarily loses its strength and behaves like a liquid

Impacts

- Buildings + bridges collapse

    - People left homeless
    - Business destroyed causing unemployment
    - High cost to repair
- Loss of life: people are killed + injured by collapsing buildings + bridges
- Transport links e.g. roads, railways are blocked by collapsed buildings
    - Aid workers cannot get through
    - High cost to repair
    - Economic loss due to loss of days of work
- Electricity lines + gas pipes are damaged so there is no electricity or gas supply
- Underground water + sewage pipes are broken causing loss of clean water supply + contaminated water
    - Diseases spread

Physical factors

- Magnitude of the earthquake
    - Higher magnitude earthquakes will cause more damage because there is greater ground shaking
- Depth of the focus
    - Deep focus earthquakes will cause less ground shaking at the surface
        - Much of the energy is absorbed by the crust as the seismic waves pass through it
    - Shallow focus earthquakes have more energy at the surface = more ground shaking
- Distance from the epicentre
    - As the shock waves spread away from the epicentre they become weaker
    - The strongest ground shake is found at the epicentre
- Geology / rock type
    - Loose sedimentary rocks may experience liquefaction and cause buildings to sink
    - Buildings on solid rock are less likely to be damaged.
- Time of day / year
    - Earthquakes which occur at night often have greater death rates
        - People are asleep indoors and at risk from building collapse
        - More difficult to rescue
    - Earthquakes in winter time have more secondary deaths
        - People may die from exposure/cold when they are made homeless

Human factors

- Population density
    - There is likely to be higher deaths + injuries in densely populated urban areas
- Building construction + design
    - Poorly constructed buildings are more likely to collapse
    - In MEDCs buildings are earthquake resistant and designed to move with the ground shake without collapsing.
- Community preparedness
    - In areas which are developed and earthquakes are frequent, the government, emergency services and people have planned for earthquakes

Reducing impacts

- Impossible to predict the exact time
- Buildings techniques
    - Reinforced foundations deep in the ground to increase building stability
    - Rubber shock absorbers between the foundations and the building structure to reduce building movement
    - Reinforced steel frames and reinforced corners of buildings to increase building strength
    - Counterweights to reduce the building sway during the earthquake
    - Automatic shutters to come down over windows and prevent the glass breaking and injuring people
    - Pyramid shaped buildings to reduce the weight of the top of the building and make the building more stable

    - Open areas around the buildings for safe evacuation
- Educate people for being prepared for earthquakes
- Train the emergency services
- Land use planning
    - Solid rock experiences less shaking than loose sedimentary rocks
    - Flexible gas, water and power lines can be used to reduce chances of them breaking when the ground moves
- Aids
    - Emergency aid
        - Provide search + rescue from collapsed buildings, temporary shelter, food and clean water
        - Reduce the number of secondary deaths.
    - Long term aid
        - Provide the money to rebuild homes and services e.g. schools and hospitals

LEDCs & MEDCs

- (In LEDCs)
- Buildings are poorer quality
    - The government and people do not have enough money to build earthquake resistant buildings
    - Many people live in shanty towns in poor quality buildings on steep slopes which are vulnerable to landslides
- Emergency services not as well trained
    - Government does not have the money to train fully the emergency services
- Transport infrastructure is worse
    - It is more difficult for emergency services to reach the injured people
- Health care services are worse
    - Fewer doctors + nurses
    - More people die from treatable injuries

Mount Sinabung Case Study

2022年11月15日 20:07

Basic information

- Located in North Sumatra of Indonesia
- On the Pacific Ring of Fire
- Kept dormant for 400 years
- It first erupted in late August 2010, and then in September 2013.
- The major eruption broke out in February 2014, and has kept erupting
    - 16 people were killed

Explanation

- Destructive plate boundaries
- Indo - Australian plate meets with the Eurasian plate
- The denser Indo-Australian plate (oceanic plate) is forced to subduct under the Eurasian plate (continental plate)
- The subducting plate melts in the mantle
- Newly melted magma rises up to the surface through cracks in the Eurasian plate because it is less dense than existing magma in the mantle
- Volcanic eruptions occur, lava and ash cools to form a new layer of the stratovolcano

Materials Erupted

- Volcanic ash
    - Ash clouds reaching over 5000 metres high
    - Engulfing nearby villages, damaging property and crops and poisoning animals
    - Trees toppled and scorched
    - Unable to see clearly
- Lahars
    - Carrying rocks thrown down by the mountain down river valleys
    - Bridge destroyed, surroundings covered in mud
- Pyroclastic flows
    - Moved up to 5.4 km
- Lava flow down the southeast slope
- Poisonous gases
    - Carbon dioxide and sulphur dioxide released

Impacts to the environment

- Lava flow in river
    - Contaminated local water resources
- Ash plumes
    - Air pollution as it lingers in the air
    - Blocked the sun and disrupts natural vegetation from photosynthesis
- Wildlife killed by the ash and pyroclastic material and lost their habitat
- Ash deposit
    - Covered the land creating new layer of ash and lava
- Natural forests destroyed by pyroclastic flows

Impacts to people

- 16 killed and hundreds injured
- Respiratory problem from ash in air
- Buildings destroyed by the weight of the volcanic ash
- Surrounding villages were abandoned
    - Thousands evacuated and 30,000 displaced
    - Vast numbers of people took refuge in temporary camps and shelters

- Crop destroyed by ash, resulting in poor harvest
    - 8000 hectares farmland destroyed, causing €8 billion of crops lost
- Infrastructure destroyed e.g. sewage pipes destroyed
- Water supplies contaminated by ash
- Road blocked restricting access for aid

Short-term effects

- The volcanic ash produced as a result of the eruption caused damage to many villages.
- Many houses were destroyed as they collapsed under the weight of the ash.
- Ash plumes caused air pollution.
- Thousands of people were evacuated to temporary camps and shelters.
- There was a shortage of clean water for people.

Long-term effects

- 16 people died
- Ash produced by the volcano caused long term health issues and many local people experienced respiratory problems.
- Ash began to blanket villages and cities in North Sumatra e.g. Medan
- Many farmers lost their crops causing many areas surrounding the volcano to experience food shortages and increased food prices.
- The crop damage also caused long term economic loss to the region
- Long term environmental damage caused by valleys being filled with pyroclastic material and some wildlife was poisoned by the toxic gases
- Government is now helping people with the long term economic costs of rebuilding homes and replanting agriculture

Reasons for not leaving

- Job opportunities
    - Becoming a local guide for tourists, hospitality provide good source of income
- Finding volcanic ash useful for fertile soil
    - Increased crop yields for food for locals and coffee and tropical fruit for export
    - Ideal climate for growing crops with hot and wet equatorial climate
- Scientists monitoring volcano and researching to develop greater understanding of volcanic activity to improve prediction techniques
- Mining sulphur in the area
- Unable to leave
    - Cannot afford to leave
    - Their farm, plantation, etc. is located here (cannot make living elsewhere)
- Don't believe in the scientists or the government
    - Thinking that the volcano won’t erupt in a long time

Haiti Case Study

2022年11月21日 18:40

Basic information

- 12th January 2010
- Richter scale magnitude 7
- About 17:00 in the afternoon
- Epicentre 24 km SW of Port au Prince
- Shallow focus of 10km below ground

Plate boundary

- Conservative plate boundary
  - North American plate moving west and Caribbean plate moving east
  - Plates moving in opposite directions
  - Sliding past each other
- Plates are stuck due to friction and are jammed together for over 250 years since last earthquake in 1750s
- Pressure build up between the plates
- When the plates are eventually able to move there is a sudden release of pressure
- Pressure is released as seismic energy
- Seismic waves travel to the surface, causing earthquake
- Plates moved 2m

Hazards

- Primary hazard:
  - Ground shaking for 50 seconds during main quake
  - Strong aftershocks of magnitude 6 up to a week later

Social impacts

- 230,000 people killed
- 50% of buildings in Port au Prince collapsed or damaged, 180,000 homes damaged due to poorly built concrete construction
- 1.5 million people displaced
  - Stayed in temporary refugee camps
  - Still 1 million living in these camps after 1 year
- Public infrastructure destroyed or damaged
  - Hospitals destroyed leaving insufficient medical provision
- 1300 schools damaged or destroyed
- Cholera came to Haiti with aid workers
  - 4,000 people died of cholera in the camps in November 2010

Economic impacts

- Port and airport became unusable
  - Aid cannot enter
- Roads blocked by piles of rubble and become unusable
- High cost to rebuild public services

Political impacts

- Government buildings collapsed and hundreds of government officials died
  - Difficult to manage the rescue and the recovery
- Haitian Government and international aid agencies criticised for poor management of the recovery