ISHIGAKI

A tropical island in Japan

Wes Gibbons 2017

Introduction

Ishigaki-jima is a Japanese island in the western Pacific 10,572 kms from Barcelona. It is so far south in Japan that it is only a little over 300km from Taiwan, 620km from the Philippines, and nearly 2,000km from Tokyo. It is safe, scenic, usually relatively uncrowded, has interesting rocks exposed on gorgeous beaches, and so comes highly recommended by The Traveller. It is also a possible starting point for WWIII, as it administers the disputed Senkaku (Japan)/Diaoyuta (China) islands. Just occasionally is hit by spectacular tsunamis.

In this guide we offer some practical information to help the indie traveller decide whether, when and where to go. Most people go there for the boat trips, food, drink, beaches, reef snorkelling and a sense of the jungle. In this guide we go a little further and include not only general information but also add an account about the fascinating geology of the island: it would be wrong not to. We have done our best to ensure all the information is correct but if you notice any errors or necessary updates then we would appreciate them being sent to us at Bimón Press (bimonpress@barcelonatimetraveller.com).

Arrival

Ishigaki has a tropical rainforest climate with high humidity, poisonous snakes, lovely beaches and gorgeous reefs drenched by fierce sunshine when it is not cloudy. It is unsurprisingly very green and reminiscent of Hawaii, with the sugarcane but without the volcanoes. A good time to go is around Easter before the rainy season and really high humidity start (but don't coincide with Japanese Golden Week): don't expect it to be dry all the time but you can be lucky and have little or no rain. A bad time to go is during a passing typhoon, which can happen anytime in July to October.

There are now no ferry services to Ishigaki-jima so flying is your only option. However there is a modern, attractive airport (Ishigaki Kuko) with good bus and taxi connections. Flights can be expensive but bargains exist, especially if you are travelling from outside Japan. In 2017 for example return flights from Barcelona as low as 520 € were possible, changing planes in Germany and Japan (Nagoya or Tokyo: avoid making the Haneda-Narita transfer in Tokyo). If flying east, a flight leaving in the morning and arriving in the early afternoon next day is about as civilised as it gets and the timing allows you to train to minimise the jetlag by getting up increasingly early the week before.

To avoid overbooking problems always get in the check-in queue early, even if you have checked in online and are only travelling with hand luggage (which is what we do). This is especially the case if something odd happens, like only one of you gets an email allowing check in online. We flew with ANA using Lufthansa via Frankfurt and Nagoya. Nagoya airport is great: stay at the Toyoko Inn but be ready for an insane rush with coachloads of tourists at breakfast time. The ANA and Lufthansa planes and cabin staff on our flights were excellent but there is little obvious communication between the two companies so you need to check in with both during the journey. Flight overbooking can be ok if you are happy to stay another day and take the compensation offered, but I normally prefer to fly on the seat and plane I booked.

Where to stay

There is a wide range of accommodation options available in the only town on the island, which I shall refer to as Town (machi). If you choose a place out of Town you are likely to be miles from anywhere and with no night life, even if it does have a nice beach. Having previously experienced and enjoyed traditional ryokan accommodation elsewhere in Japan, we prefer to go on less expensive holidays rather than blow it all on one binge, but realise that others may not share this priority. Thus we have become accustomed, even addicted, to staying in the no-frills Toyoko Inn chain business hotels. These are cheap, clean, female-friendly (the boss is a woman), have small western-style rooms with en suite bathroom, free Wi-Fi, and plenty of cold beer in the vending machines. The price includes a serve-yourself very Japanese breakfast and is quite an experience. Book directly with them online months in advance (joining their membership scheme) and ask for a high floor. Note that if you want your room cleaned in a Toyoko Inn you must leave your room by 10.00 and cannot return before 16.00. When you check in remember to take a (free) yukata cotton robe from the cabinet near the check-in desk to wear in the room.

The Toyoko Inn in Town is a ten minute walk through the industrial harbour from the bus terminal. Not exactly scenic but it does the job, and you do get the opportunity to pass a statue of the town mascot.

There are many restaurants within a 15-minute walk back to Town, and most (not all) offer some kind of English menu once you are inside, or you can just rely

on photos, a smile, and a few Japanese words. We prefer the authentic "izakaya" bar-restaurants, which are usually friendly to "gaijin" (you and me), and we avoid anywhere obviously touristy or overtly begging for our custom. The much-vaunted local beef is very expensive, but normal dishes are not. In fact, if you can get a good flight deal, eschew the temptation to stay in a ritzy hotel or resort, and do the day touring yourself without paying an agency, then for the distance travelled and the exoticism of being in the tropical Pacific, an Ishigaki holiday can be surprisingly good value.

Getting around

To move independently out of town and on land you need a car, scooter or bus pass. A bicycle is not a realistic proposition for anyone with normal capability unless you cycle only close to Town, which would be pointless. A car is the easiest, most comfortable, flexible and fastest option but it is the least environmentally and financially friendly, and parking regulations and spaces can be a real hassle. A scooter is more fun but less so in the rain and if you have an accident: after an incident on Lipari in the Aeolian Islands, The Traveller does not hire scooters. There are very few walking routes inland (think: jungle) although Banna Park offers inland recreation and is not too far north of Town. Climbing the two peaks of Nosoko (282m) or Omoto (526m) is hard, sweaty work and (especially for Omoto) includes the chance of encountering venomous snakes, spiders and insects, and you need your own transport. We preferred travelling by bus and leisurely walking along the beaches and minor roads. This meant that several places were too difficult to get to, but we didn't feel especially penalised. Note that you will not need your own transport for all days: there are ferry trips to other islands to be made.

The 5-day bus pass is very good value (2000 Yen for 5 consecutive days) and you can go all over the island, but the timetables are erratic and rather complicated. We found travelling by bus real fun and nearly cried when our bus pass ran out, although you have to go with the flow, be patient, be alert to a few tricks (like buses running a few minutes apart with the same number but splitting into different routes: that one really fooled us, so be careful with the No. 11), and be prepared to change plans if the weather changes or you have made a mistake with the timetables, or (as in one case) the English version of the timetables proves to be inaccurate. Inland scenery is verdant and rural but not dramatic: the coastal routes provide the best views. The following advice and information is for those who decide to go for a bus pass. Bus timetables and a good map can be found on:

http://www.kotsu-okinawa.org/en/map_yaeyama.html#ishigaki

The first decision is when to buy it. We decided to spend the middle part of our visit travelling by bus, sandwiched between boat trips to neighbouring islands. The reason for this was partly the weather forecast but mainly the fact that deciding on a visit to Taketomi Island on our first day offered a wonderful opportunity to walk off the jet lag after so many hours inside a plane, enjoy wading into the ocean on a perfect beach, and consider going the total-tourist with a buffalo cart ride. So on arrival at Ishigaki airport we firstly had lunch (surprisingly good and well-priced), picked up a copy of the bus timetables in English from the tourist office, took a bus from the airport to the bus station (Y1000 return or Y540 single) and Googlemapped our way to the Toyoko Inn in time for an early check in (join their membership scheme for this: it is worth it). The bus ride is not scenic and the suburbs grey and unattractive, but it does not take long and you can spend the time wondering whether a tsunami is about to strike the southeast coast: this is where they do the most damage as the low gradients can make for a grand run-up of tens of metres above sea level.

The first morning we recommend a preparatory reconnoitre and stock-up. Follow the back road that heads northeast from the park beside the Toyoko Inn, passing traffic lights then a park (on the right: it has a peace bell) to a traffic light crossing with a main road where there is a Lawson supermarket (useful for water, Pocari Sweat, nuts and bananas). Just before reaching this main road and Lawsons there is an indoor market (across a car park on your right) which is good for other foods and anyway worth a visit in itself. From Lawsons follow the main road southeast into the town centre, passing (left) a zone of narrow streets that include the covered Ayapani Mall. This is a good place to buy a wide brimmed hat, which is an essential piece of field equipment on Ishigaki-jima. You are now ready to go.

The bus pass tour

The photo above shows Ishigaki bus station and features The Big Squeak (No. 11), our personal favourite. You buy your bus pass inside the bus station, not the bus. There are 2 types: 1000Y for 1 day, or 2000Y for 5 consecutive days (Michikusa pass: unlimited travel on all routes except special tour buses), which looks like this:

Here is our 5-day itinerary, based on 2017 Azuma bus timetables. You will presumably want to design your own. Our route was planned with weather, geology, and tides in mind (better to enjoy the beaches on a falling or low tide).

Bus routes on Ishigaki: http://www.kotsu-okinawa.org/en/map_yaeyama.html#ishigaki

Day 1

10.45 No.8 bus to Palm Groves (Yonehara Yashibayashi Iriguchi) arriving 11.43. Walk back a short distance then turn right to walk 5 mins uphill to the Palm Groves and a short walk into the jungle. Buy a freshly squeezed sugar cane juice just to watch them make it for you.

Tastes pretty good too. Return to main road (it has a sidewalk) and walk 1km west downhill to Yonehara beach. This beach is famous for its reef snorkelling and rip currents, but you can just enjoy the beach and coralline sand.

You can either continue west to Kabira on the 13.18 No.8 or (as we did) head back to Town on the No.11 at 13.22, have lunch then head out on the bus No. 9 departing the bus station at 16.15 to bus stop Funakura No Sato (arrives 16.30) to enjoy the triple sights of the Tojinbaka Memorial, Kannonzaki lighthouse and Kannon-do Temple, the latter involving a short, pleasant walk along the coast before turning left inland. Beware that the bus No.9 back seems to run 10 mins earlier than the 17.49 marked on the English schedule. For the geologists among you, the cliff below the lighthouse exposes oceanic sediments of the Fusaki “Formation”, mostly pale cherts, disrupted within a low grade subduction accretionary prism sequence (see photos in the geology section below). Back in Town your cold awamori awaits you.

Day 2

Bring all food and drink for the day. Bus No.8 leaves at 10.45 for Ibaruma arriving 12.12. Enjoy the beach on the west side of this isthmus: access towards the north is blocked by a low barbed wire fence (unsure if this means no access to people on foot: we think not), but to the south there is a long beach walk to a distant rocky headland. During this walk you will pass magnificent boulders of reef limestone brought inshore from the reef moat on tsunami waves: beyond the moat you can see the surf pounding the reef out to sea (see photo in geology section below). The rocks at the southern end of the beach are volcanic (andesitic breccias, agglomerates, tuffs and lavas: see photo in geology section below). If you want to make a day of it, walk over for a picnic lunch on the roofed tables provided in the western harbour at Ibaruma, then Googlestreet south on the narrow backroads to climb the tourist hotspot observation platform and gardens of Tamatori-zaki.

The buses travelling south from Ibaruma stop here: just walk down to the main road east of the observation platform and cross the road to catch the 16.53 (No. 2) or 18.09 (No. 6) back to Town. Your cold beer awaits you.

Day 3

Catch number 6 bus at 11.20 towards the northern Hirano peninsula, getting off at Akaishi at 12.32 (the bus runs up a spur road to the right, drops you off then returns to the main road). This is a nice little place, with a café and beach access through the mangrove forest. Walk south along the beach to find fantastic exposures of metamorphic rocks that formed deep within a subduction zone (see photos in geology section below). With a good picnic lunch you could spend all day here in Akaisha and get the 17.58 No. 6 bus back, but we chose to return on the southbound 13.53 No. 6 bus to the airport.

Change at the airport on to the 15.00 cross-island No. 11 bus (a.k.a. The Big Squeak due to its distressed suspension) and celebrate by getting off at Kabira for an Island Coffee ice cream from the corner restaurant/shop by the bus stop. Kabira is a tourist trap overrun by coachloads of visitors, but it is worth a visit to the beach and coral limestones of the Ryukyu Group (see geology section below) and decide whether to make the traditional outing by glass-bottomed boat to admire bleached coral.

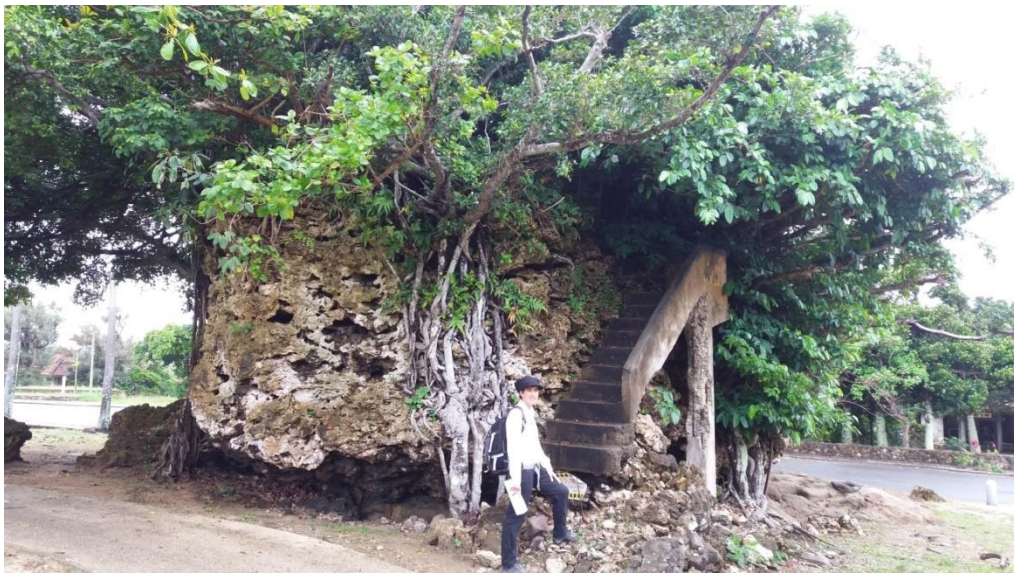
Day 4

No 8 bus to Sakaida arriving 11.14. Walk back south to just before the coast and enter the road to the right that runs along the south coast of the Yarubu Peninsula. After 2.5km along this pleasantly rural road you cross a bridge over a small river and take the first beach access on the left then turn right to continue southwest along the beach for 2km to the tip of the peninsula. Nice coastal walk, rewarded by more blueschists (metabasites and, at the end, metagabbros and metasediments: see geology section below) similar to those seen yesterday. Best done on falling tide: we had the whole tropical beach to ourselves as, unlike Kabira, this is not on the tourist route.

Walk back to re-cross the road bridge then take the first right to access the beach again and walk southeast (left) to Akazaki (tip of the peninsula) to see exposures of Fusaki mélange cut by dykes. Rounding the peninsula at low tide you can find the same white cherts as seen below Kannonzaki lighthouse, but here more obviously disrupted into the mélange: see photos in geology section below. Unless you dare to continue east and look for an access up to the main road, return the way you came (as we did) and take the 15.39 No. 2 bus (not Sundays or holidays) on to Kabira arriving 15.48. Hang around Kabira a bit more then take the 17.20 number 9 bus to enjoy the scenic route back to town.

Day 5

Take No. 4 bus at 10.00 or 10.30 east towards the airport but after 18 minutes get off at Ohama. Walk 3 blocks southeast then turn left to reach a pretty little park (right) and primary school (left). In the northern corner of the park is a famous giant boulder of reef limestone washed up by a tsunami. This is "Tsunami Ufuishi": read the fascinating story of this rock in the geology section below. The now-derelict steps up the overgrown boulder once led up to a shrine.



Turn right at the boulder to follow the road 150m southeast to the beach and turn right to find exposures of gently dipping Miyara Group sandstones containing metamorphic clasts, overlain by reef limestone (see photos in geology section below). Return inland past the park to the primary school.

Return to the bus stop to catch the 11.38 No. 6 bus to Hirano (last stop, arriving 12.50). You either have lots of time (return bus No. 6 at 17.40) here or not enough (bus No. 6 at 13.35). We choose the latter and rushed down the network of small roads that drop to the north coast, turned right on the beach to find more blueschists with lots of nice folds verging towards the north (see geology section below). Everyone else got off before the end of the line and rushed to photograph the lighthouse. Each to his or her own.

Return on the 13.35 No.6 bus and change at the airport again (after an ice cream) onto the Big Squeak No. 11 bus at 15.00 which runs up the Kabira Peninsula, past the Club Med and arrives at the Seaside Hotel (17.15). Walk across car park and a few metres west to emerge on to Sukuji Beach. This is another of the "mustdo" stops on Ishigaki but we arrived late and it was threatening to rain so the place was pretty deserted. Very nice. About a kilometre long and with exposures of andesites on the north side. Didn't see any venomous jellyfish or sea snakes, but the mosquito repellent was useful.

Return from the hotel car park on the 19.10 No 9 bus again (it may arrive late, don't panic).

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Now I offer a few notes on visiting the two islands of Taketomi and Kohama, both highlights of our visit, although the geology was not very accessible so these days for us were more typically touristic. One of the highlights of the trip is the boat ride itself: you are ferried at quite dizzying speed across the blue lagoon enclosed by the main reef ringing the islands.


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Taketomi

Taketomi island is a tourist hotspot so there are frequent ferries and even more frequent tours using private ferries. If you prefer to escape the tour crowds and explore on foot, then we suggest walking from the port anti-clockwise along the coastal road to the northern tip of the island then due south to the central village where there are food and drink options. We choose the Haa Ya nagomi-café up on a higher floor overlooking the concrete lookout tower in the centre of the island. The tofu burgers and cold beer were most welcome. You can climb through the building to admire views from their tsunami shelter on the roof.

Now walk south through the village then southwest to beautiful Kondoi Beach for a paddle or swim in the lagoonal ocean. The white coral reef sand is unforgiving: bring flip-flops. The number of people here seems to depend on how many tourist buses are parked.

Then walk south along the beach to Kaiji Beach, another hotspot due to the presence of tiny, delicately star-shaped forams in the sand. Overrated, overpromoted and, when we were there, overrun with tour groups. If you can't find any yourself there is someone there to sell you some. How lucky is that? Star-shaped foraminifera are indeed beautiful, but all the cash-driven hype promoting them is not.

From here we walked back inland then took a track to the eastern coast, returning along a dirt road that leaves the beach just south of the eastern tip. A pleasant walk but nothing special and it was very hot (in April!). In summary, there is not a lot to do on Taketomi but just to walk or cycle around, chill out in the village and on Kondoi Beach, and consider having a buffalo-driven cart ride. The place is special and unforgettable, a Japanese Sark, and so really is worth the effort, although try and choose a day when it is relatively uncrowded. It must be quite something at night when all the daytrippers have gone.

Kohama

Kohama island is very different from Taketomi. There are fewer tourists and more farms and cars. We walked but it is probably better to cycle here as you will see more of the island. The main highlights (apart from the boat journey) for us were:

(1) Discovering an almost deserted tropical beach on the north coast, around halfway along the road running west from the harbour: a little road runs off to the right northwest through a holiday housing development area down to a parking spot and path to beach. If you like beaches and the water you could spend all day here, but bring all food and drink. And if you swim or wade around that headland (Ryukyu Group limestones), the geological map says there are blueschist-grade metagabbros of the Tomuru Complex exposed in the cliff: but don't tell me about it as I wasn't allowed to go. The Traveller worries about venomous metre-long sea snakes and the fact that I can't swim properly.

(2) Climbing up the steps to the highest peak in the middle of the island, enjoying the views, and listening to the wildlife.

(3) Visiting the little corner cafe on the right as you leave the central village on the way back to the port.

(4) Walking across the broad beach south of the port at low tide to visit exposures of Miocene sediments (see geology section below).

We did not have time to visit more islands but will do so if we return to Ishigaki. In particular we avoided the organised tours that seem to have overwhelmed daytrips to Iriomote. Maybe it would be more rewarding to do this island as an indie traveller with a hire car (or using buses) and spend a night there. As a final comment, reading about Ishigaki and the other islands you will learn about a host of terrifying or just plain annoying beasties: poisonous snakes, spiders, ticks, leeches and so on and so forth. We didn't have any problem apart from the occasional mosquito and seeing a dead snake on Taketomi, which was more of a problem for the snake than for us.

Last stop at the bus station…time to fly to Nagoya.

And so goodbye to Japan passing distant Mount Fuji…hasta la proxima.

Useful websites

General: http://www.ishigaki-japan.com/

General: http://wikitravel.org/en/Ishigaki

Bus: http://www.kotsu-okinawa.org/en/map_yaeyama.html#ishigaki

Boat: http://aneikankou.co.jp/languages/e_index.html

Boat: http://www.yaeyama.co.jp/

Accommodation: http://www.toyoko-inn.com/e_hotel/00214/

Geological map: https://www.gsj.jp/Map/EN/geology2-8.html#Ishigakijima/

Classic USGS Memoir on Ishigaki geology written by Helen Foster in 1965: https://pubs.usgs.gov/pp/0399a/report.pdf

About Helen Foster: http://www.aapg.org/publications/news/explorer/details/articleid/11791/prowess-honors-a-career-of-seizing-opportunity

New book on Geology of Japan: https://www.geolsoc.org.uk/gojapp

Holiday Geology Guide to Ishigaki*

An illustrated introduction

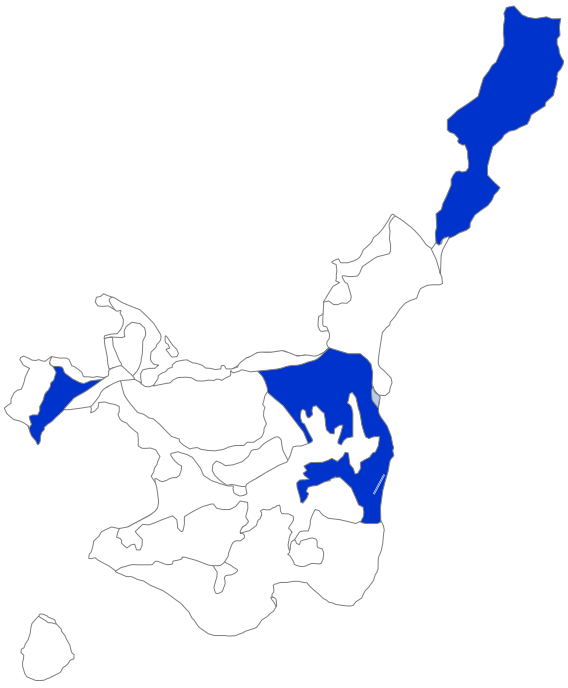
Wes Gibbons 2017

You don't have to be a geologist to find the rocks on Ishigaki-jima interesting and even amazing, you just need to be curious about Planet Earth. These rocks, which are exposed in easily accessible coastline locations, preserve events that happened millions of years ago here on the far eastern edge of the Eurasian plate. They take you into Deep Time and, for the oldest rocks, into the Deep Earth.

The oldest rocks: beautiful blueschists

The oldest rocks exposed on Ishigaki-jima are entirely "metamorphic", that is they have been changed by pressure and heat after being buried deep within the Earth. The term "metamorphic" was introduced by the Scottish geologist Charles Lyell who was thinking of the opening phrase of Ovid's poem *Metamorphoses* which begins "Of bodies changed into new forms I speak".

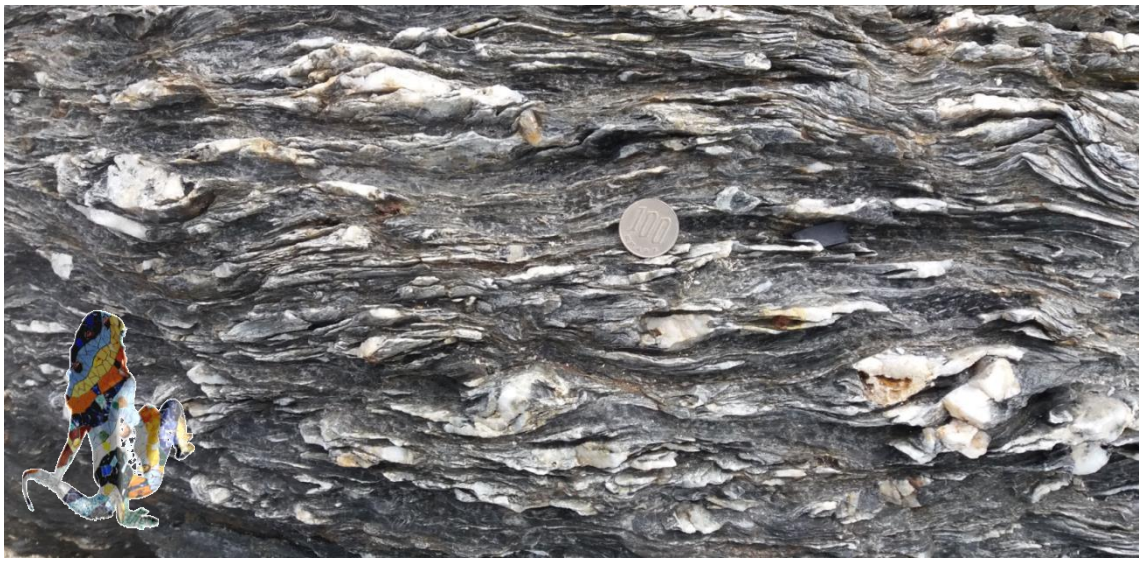
The metamorphic rocks on Ishigaki-jima belong to the "Tomuru Complex" and mostly comprise a series of metamorphosed basalt lavas and sediments. They began their existence way out in the Pacific Ocean, thousands of kilometers from the Asian coast, but then were carried slowly westwards by their tectonic plate until they were forced under the continental margin to depths of around 30 kilometres below the surface, a process called "subduction".



When basalt lava is subducted "rapidly" (that is, at plate tectonic speeds of centimetres per year) down to depths of 20-30 kilometres it turns blue and green due to the growth of new minerals such as bluish amphiboles and green epidote. Blue amphiboles are more comfortable growing at the increased temperatures and, especially, pressures than the original minerals crystallised in the basalt lava. Thus the lava becomes "metamorphosed" in the solid state to a new rock called "blueschist":

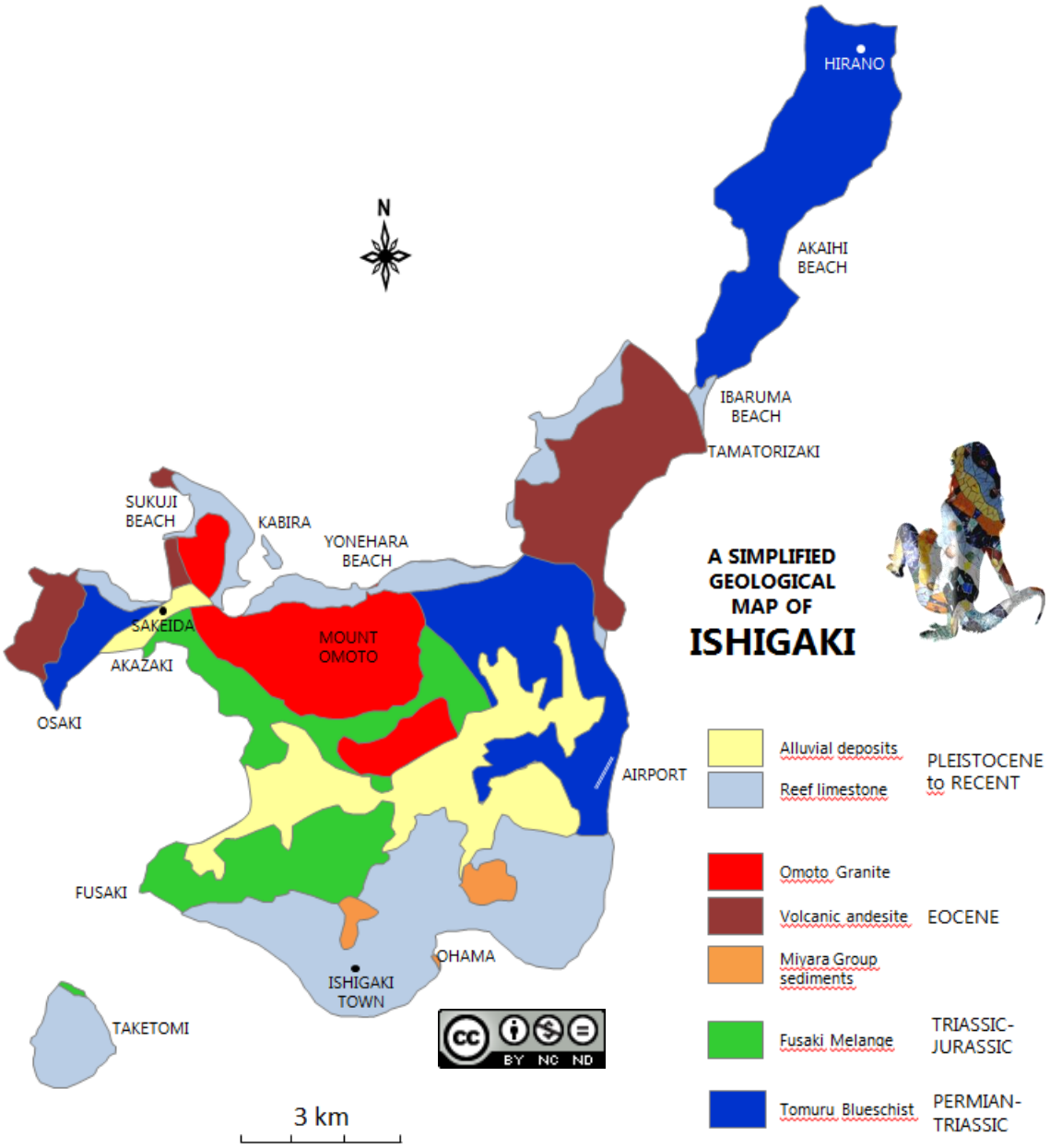
*Cite as: Gibbons, W. 2017. Holiday Geology Guide to Ishigaki. ADD WEBSITE

The photo above shows blue-green Tomuru “blueschist” exposed on Akaishi beach, northeast Ishigaki. This rock was once a volcanic lava, erupted in an ancient ocean over 240 million years ago, but has since been subducted and completely changed by metamorphism and deformation deep within a plate subduction zone. The metamorphic minerals that grew in the rock during subduction have been dated as around 190-220 million years old.

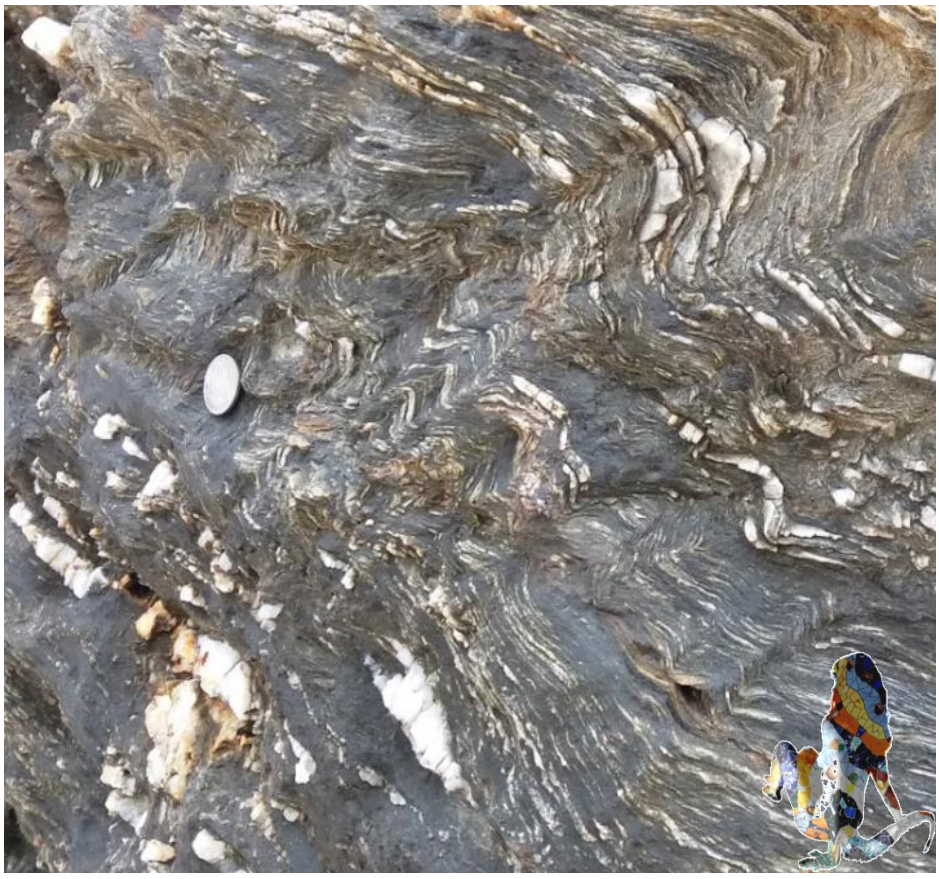


Also exposed in the cliffs south of Akaishi beach are pale grey and white metamorphic rocks (photo above) that were once deposited as sediment on the ocean floor. The mineral forming the white areas is quartz whereas the grey areas are mostly formed of a soft mica called “phengite”. Phengite, like blue amphibole, is comfortable growing under the relatively cold metamorphic conditions that characterise subduction zones: the rocks are pushed rapidly deep underground so that pressure increases unusually faster than temperature. Subduction zone rocks are thus often referred to a “high pressure/low temperature” (HP/LT). This is what makes them so unusual, and Ishigaki offers some splendid examples. Two more examples of blueschists from Akashi are shown below:

Photo below shows flat-lying blueschists on Yarubu-zaki (western Ishigaki).

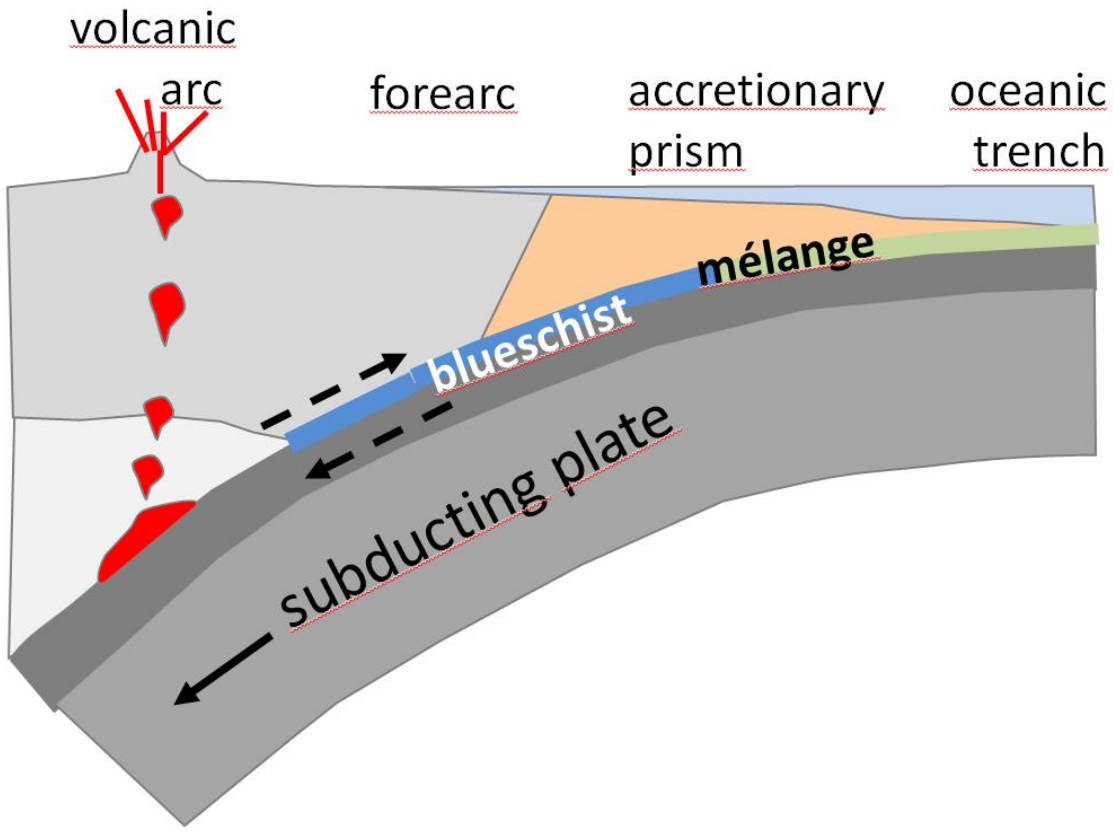


Simplified geological map of Ishigaki. Blueschists are found in the west, east and northeast. Mélange is found in the central west and southwest. Much younger (Eocene) rocks occur as sediments in the south (Miyara Group), volcanic rocks (andesites) in the northeast and northwest, and granitic rocks that form the highest peak of Mount Omoto. Much of the central part of the island is covered with young alluvial sediment, and the north and south coasts expose reef limestones both onshore and offshore.



Being forced down a subduction zone squeezes and deforms the rock so that minerals become aligned to form a “schistosity” which in turn can become bent and corrugated by folding during its tectonically-enforced return to the Earth’s surface. The folds produced by this deformation in the deep earth are picked out by the white quartz layers seen in the photo above.

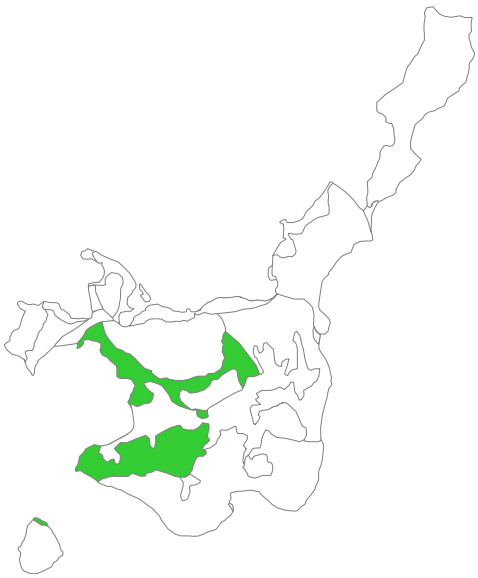
North-vergent folds in blueschists on Ura-saki beach in the far north of Ishigaki



Idealised cross section through a subduction zone on the western side of the Pacific Ocean, *looking north. The oceanic Pacific Plate (darker grey) is subducting beneath the Eurasian continental plate. The green area at the contact between the two plates (the "Benioff Zone") is where rocks slide slowly downwards, reaching temperatures of over 100°C, accompanied by earthquakes that become increasingly common with depth. As explained in the section below, "mélanges" form as oceanic sediments and lavas are scraped off and mixed in the downgoing plate to form a triangular "accretionary prism" (yellow). Below this the rocks become increasingly dry and metamorphic under temperatures reaching up to 350-450°C and recrystallizing to form blueschists (blue area). At greater depths, release of fluids from the subducted rocks results in melting of the overlying plate and the production of magma (red) which rises to build a volcanic arc at the surface.*

The mysteries of mélange

An important rock unit exposed on Ishigaki is that of the Fusaki Group. This is best exposed on the coast at the Fusaki peninsula beneath the Kannonzaki lighthouse in the southwest, and at low tide on the peninsula of Akazaki near Sakeida, 6km north of Fusaki.



The Fusaki rocks have not suffered the deep subduction metamorphism seen in the Tomuru Complex, but they are far from being in original pristine condition. The photo above (taken at Fusaki) shows pale, flinty “chert”, a sedimentary rock deposited as thin layers (or “beds”) on the deep ocean floor far from land, but then deformed by folding (note the tightly folded bedding on the left in the photo below).

Pale bedded cherts at Fusaki. These rocks were deposited and consolidated excruciatingly slowly over tens of millions of years around 200-240 million years ago. The pale layers consist of countless numbers of the siliceous skeletons of tiny (0.1-0.5mm) planktonic animals called radiolarites. These animals live in the photic zone of the ocean for a few weeks before sinking to the ocean floor which becomes covered with "radiolarian ooze", later buried by more falling animals and hardening into rock. The lack of any carbonate fossils in these rocks indicates that they were deposited below the "carbonate compensation depth" (CCD) in the ocean. Below the CCD the water pressure is too great and carbonate dissolves. The current CCD in the tropical ocean is at a water depth of around 5 kilometres so we can deduce that the Fusaki cherts formed in the very, very deep ocean.

Fusaki Group rocks exposed on the beach at Fusaki (looking north). If you look closely to the left of the Pocari Sweat bottle you can see tiny folds corrugating these deformed sediments. The Fusaki Group may not have been metamorphosed to blueschists like the Tomuru Complex, but it has been very strongly deformed. This deformation also occurred during oceanic plate subduction, although the Fusaki rocks were never buried as deeply as those of the Tomuru Complex.

Exposures on the Akazaki peninsula (looking north) demonstrate how much of the Fusaki Group has been thoroughly broken up into a mixture or "mélange" of rock fragments. In the photo below blocks of harder rocks lie immersed in a fine matrix of deformed softer, muddier siliceous sediment.

The term “mélange” was first introduced by the British geologist Edward Greenly in his “Geology of Anglesey” published in 1919. This unusual rock has generated much controversy and confusion, mainly because it seems there are several ways to thoroughly mix up rock strata. For example, massive collapses of submarine cliffs can generate great rock slides that sweep into deeper water and deposit as chaotically mixed materials: a type of mélange that came to be known as an “olistostrome”.

A common way to produce mélange is within a subduction zone where great masses of oceanic sediment slide beneath an overriding plate and rock strata are torn apart by the extreme shearing and flattening forces involved. Given the position of the Fusaki rocks on a subducting plate margin and their association with blueschists, mixing within a Pacific subduction zone is the most obvious explanation for their origin.

The Fusaki mélange exposed on the Akazaki peninsula includes pale cherts like those seen at Fusaki, but here more obviously broken up within the melange.

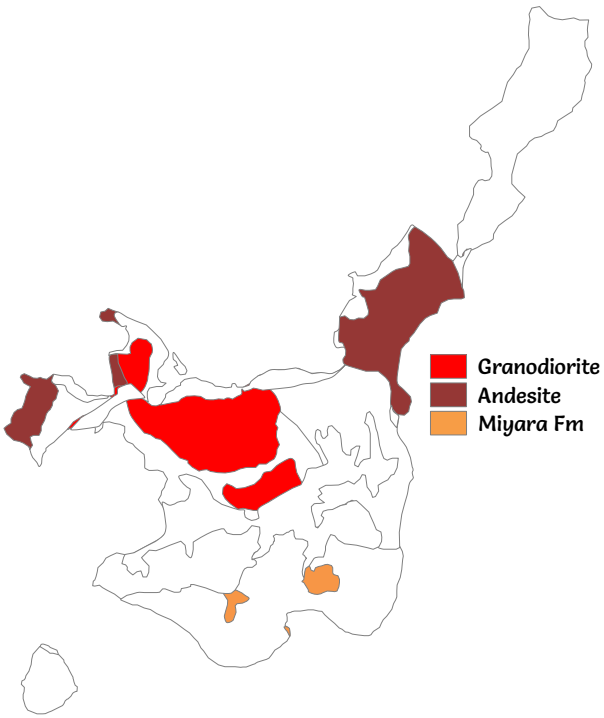
The mélange includes pieces of chert, sandstone and in a few places limestone and basalt lava, all immersed in a siliceous mudstone matrix. The Fusaki Group sedimentary rocks have been variously dated using radiolarian fossils as having been deposited over the long period from around 300 to 175 million years ago. For most of this time (300-200 million years) chert was deposited, but then as the oceanic plate approached the Asian continent, so more mud (mostly brought to the ocean by river erosion of the distant land) became mixed with the siliceous ooze.

Close up of a coarse sandstone block within the Fusaki mélange exposed on Akazaki headland. Some of the individual sand grains in the sandstone are almost the size of the hole in the coin: such rocks are very unlikely to be deposited in the deep ocean far from land. The younger part of the Fusaki Group sedimentary sequence contains coarser sediments like these. They were eroded from the nearing landmass as subduction began and the mélange created sometime after 175 million years ago.

During their subduction the Fusaki sediments became scraped off and stuck to the overriding plate as a great wedge of accreted rocks developed in front of the continent (an “accretionary prism”). Mineral ages (from fine white micas) in the Fusaki mélange suggest that the unit was gently metamorphosed at high levels in the accretionary prism around 129-144 million years ago. Sometime later the Tomuru blueschists and the Fusaki mélange were brought together by faulting.

One hundred million years later: Ishigaki becomes volcanic

As is commonly the case in geology, the geological record on Ishigaki is extremely incomplete. The next rocks to be preserved after the deposition, subduction, deformation and uplift of the Fusaki Group are much younger, that is around 40 million years old which makes them Eocene in age. They comprise a group of sediments called the Miyara Group and volcanic rocks called the Nosoko Group. Miyara Group sediments are not metamorphosed and lie upon the older Tomuru/Fusaki basement, and the Nosoko volcanics lie on top of (and are therefore younger than) the Miyara rocks.



Eocene rocks of Ishigaki

Ohama shoreline: Here the lowest part of the Miyara Group sediments is exposed. They are coarse grey-brown sandstones containing large pieces eroded from the underlying Ishigaki metamorphic basement. Inland, the Miyara sandstones are overlain by coralline limestones, also of Eocene age. The sequence can be interpreted as recording a time when the old basement rocks of Ishigaki became covered by the sea, with the sandy shoreline overlain by reef limestone as the waters rose slowly across the land surface. Much later, in Pleistocene times, more reef limestones fringing the island were deposited over the Miyara, Nosoko, Fusaki and Tomuru rocks. These Pleistocene limestones are known as the Ryuku Group.

Ohama shoreline: the Miyama sandstones here on the Ishigaki south coast are overlain by the much younger (Pleistocene) reef limestones of the Ryuku Group forming the low cliff in the background.

The photo above shows andesitic volcanic rocks of the Nosoko Group exposed on the beach south of Ibaruma. The marine transgression that deposited the Miyara sediments was followed by eruptions of andesite as Ishigaki became a volcanic arc. The transformation of Ishigaki to an island volcanic zone in Eocene times was due to the fact that it had become positioned above where hot magmas were rising through the crust of the Eurasian plate due to continued subduction of the Pacific plate below. This is the same process that is seen at subduction zones throughout the modern world, notably those around the current Pacific “ring-of-fire”.

Massive volcanic rocks made of fragmented pieces of Nosoko andesite produced during explosive underwater eruptions in the Eocene Ishigaki volcanic area around 40 million years ago. The Nosoko Group volcanic rocks occur mainly in the far west (southwest from the northwest tip of the Kabira peninsula down to the western tip of the Yarabu peninsula) and across the peninsula southwest of Ibaruma where they form the 282m-high peak of Mount Nosoko (which has a hiking trail).

Related to the same period of island arc activity, the next geological event preserved in the rock record of Ishigaki is the intrusion of granitic magma into the old basement rocks. The molten granitic mass solidified to form a broadly oval-shaped “pluton” that now forms the area around Mount Omoto (526m) in the central north. This is the highest point not only in the island but also in the whole of Okinawa. The age of this event is not well constrained, but the granite is probably around 39 million years old, just a little younger than the Nosoko volcanic rocks.

The grey granite is composed mostly of interlocking crystals pale feldspar mixed with translucent quartz, black biotite mica, and shiny white muscovite mica, like the ornamental stone used extensively at the 18thC Kannon-do temple (excursion Day 1).

Twenty million years later: Miocene sediments

A younger sedimentary event (around 15-19 million years old = Miocene age) is preserved as sedimentary rocks of the Yaeyama Group on the neighbouring islands of Iriomote and Kohama. On Iriomote the sediments include sandstones, mudstones, limestones and coals, whereas on Kohama they comprise mostly sandstones and are known as the Birumasaki Formation.

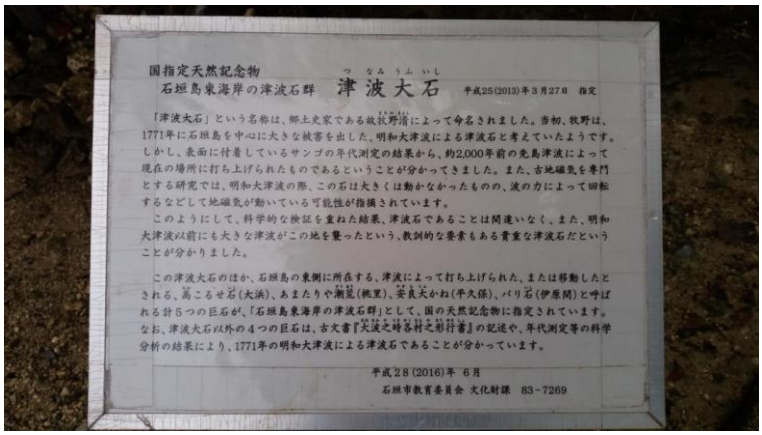
Conglomeratic sandstones at the base of the Miocene aged Birumasaki Formation (part of the Yaeyama Group) exposed on the beach 1.5km south of Kohama port. These rocks are interpreted as beach sands and gravels deposited as the sea transgressed over the Miocene land surface.

The Birumasaki sediments lying above those in the previous photo become less coarse-grained and contain fossilised mud cracks and the horizontal traces of animal burrows (probably crustaceans) recording life on a Miocene tidal shoreline long ago. Exposure on beach across bay south from Kohama Port, looking NE to Ishigaki-jima: the mudcracks appear as thin pale lines, whereas the burrows are thicker and darker.

Giant boulders deposited by tsunamis

One of the most dramatic geological phenomena on Ishigaki is the presence of huge chunks of reef limestone ripped from offshore and deposited on the shoreline by tsunami waves. The largest and most famous of these is the one named “Tsunami Ufuishi” close to the beach at Ohama, on the southeast coast of the island (see Day 5 itinerary above). The Tsunami Ufuishi boulder measures 12.4 × 10.8 × 5.9 metres, weighs over 500 tons, and originally lay at water depths of 7-10m (based on the coral assemblages that include *Favia*, *Favites*, *Acropora*, *Goniastrea*, and *Platygra*):

“Tsunami Ufuishi” resting on Eocene-age sandstones (right) of the Miyama Group at Ohama, in the park immediately east of the primary school. The overgrown giant boulder has been made a shrine and fitted with a now derelict set of steps. The information board seen to the left of the photo is shown and translated below:



Translation: “National Natural Monument. Tsunami rocks along the east coast of Ishigaki-jima　Tsunami Ufuishi. Designated on March 27, 2013

The “Tsunami Ufuishi” was named by the late Kiyoshi MAKINO, a local historian. At first, Makino thought the rock was a tsunami deposit of the Great Meiwa Tsunami that had caused significant damage on Ishigaki-jima in 1771. However, based on radiometric dating of the corals adhering to the rock surface, it has been clarified that the rock was washed up to the present location during the Sakishima Tsunami about 2000 years ago. In addition, the studies in the field of paleomagnetism have pointed out the possibility that during the Meiwa Tsunami this rock was rotated by the power of waves resulting in a misfit of geomagnetism, though not considerably relocated.

Thus, results of scientific studies have shown that this rock is unequivocally a tsunami deposit, a precious and also instructive sample illustrating that another severe tsunami had affected this area before the Meiwa Tsunami.

In addition to Tsunami Ufuishi, there are five other huge rocks located at the east side of Ishigaki-jima, these being called Takakoruse-ishi (Ohama), Amatariya Suare (Tozato), Yasura Ufukane (Hirakubo), and Bari-ishi (Ibaruma), and are thought also to have been washed up or relocated during a tsunami. Together these rocks have been designated as the National Natural Monument “Tsunami rocks along the east coast of Ishigaki-jima”. As for the four rocks other than the Tsunami Ufuishi, they have been proven to be tsunami deposits of the 1771 Great Meiwa Tsunami, on the basis of descriptions in the historical document “Onami-no-toki-kakumura-no-nariyuki-sho” and the results of scientific analyses such as radiometric dating.

June, 2016. Cultural Properties Section, Ishigaki City Board of Education.”

Further notes on the meaning of the Japanese names:

Tsunami Ufuishi（津波大石）: A big rock of tsunami. Note: “大石” commonly reads “Oishi” or “Ohishi” in standard Japanese language. Reading it “Ufuishi” (pronouncing like “woo-ishi”) may be according to the dialect around the Okinawa area. This also applies to the “Yasura Ufukane” below.

Meiwa（明和）is a Japanese era name of the period between June 1764 and November 1772, meaning “bright and peaceful.”

Sakishima（先島）is the name of islands at the southernmost end of the Japanese Archipelago.

Takakoruse-ishi（高こるせ石）: A higher Koruse rock. Note: “Koruse” is name of the location where black rocks had been brought inshore during the Sakishima Tsunami. The Takakoruse-ishi was further moved about 600 m to the north during the Meiwa Great Tsunami.)

Amatariya Suare（あまたりや潮荒）: Raging wave of Amatariya. ("Amatariya" is name of a beach.)

Yasura Ufukane（安良大かね）: A big lump of iron at Yasura. ("Yasura" is name of an area along the east coast of Ishigaki-jima.)

Bari-ishi（バリ石）: A cracked rock.

Ohama（大浜）, **Tozato**（桃里）, **Hirakubo**（平久保）, and **Ibaruma**（伊原間） are names of the villages where the four rocks are located.

Onami-no-toki-kakumura-no-nariyuki-sho（大波之時各村之形行書）: The record of events in each village at the time of the big wave.

Translation and additional information kindly provided by Tomoko Kojima of Kumamoto University, who also offered this local tale about the 1771 tsunami:

One day, fishermen from a village on Ishigaki captured a mermaid. The mermaid asked them to set her free, and when they agreed she thanked them and told them that there would be a huge tsunami in the near future. Some believed it and evacuated to Mt Omoto, while others just stayed in the village. The tsunami occurred as the mermaid had predicted, totally destroying the village. The believers (survivors) reconstructed the village, the present villagers being their descendants.

See this research paper on Tsunami Ufuishi:
http://52.172.159.94/index.php/epi/article/view/57093/44562
http://faculty.ndhu.edu.tw/~jyyen/list_of_download_files/002_goto_w.pdf

Limestone boulder of the coral *Porites* showing "microatoll" texture on Ibaruma beach (see Day 2 itinerary above). Such coralline boulders form in the "moat" area which is up to 4 metres deep and lies between the shore and the reef crest exposed one kilometre out to sea (visible in photo background). The boulder has been deduced to have been carried to the shore by the Great Meiwa Tsunami of 1771 (see the paper by Goto et al 2010). The largest boulder left on Ibaruma beach by the Great Meiwa Tsunami is called "Bari-ishi" (cracked rock: on the north side of the bay; see notes above) and weighs over 200 tons. It was cracked in two by the force of suddenly being dumped on the shoreline as the tsunami run-up wave was drastically slowed down by backwash waves reflected from the sand dunes behind the beach, generating a huge standing wave that relieved itself of its bouldery burden. The violence of these events is hard to imagine.

Overview of Ishigaki-jima geological history

1. The parents of the oldest rocks seen on Ishigaki form far away on the deep Pacific Ocean floor as basalt lavas and sediments over 250 million years ago (250Ma: Ma = megaannus). These lavas and sediments slowly move towards Eurasia until around 235Ma they begin to slide beneath the continent as their part of the Pacific oceanic plate becomes subducted. Some of these rocks descend to around 30 kilometres below the surface, losing their original identity as lavas and sediments as they become transformed into blueschists of the Tomuru Complex.
2. Meanwhile, as the Tomuru rocks are being subducted and metamorphosed, in another part of the Pacific oceanic plate countless radiolarians rain down up the ocean floor for tens of millions of years of Triassic time (200-240Ma). These biological deposits slowly accumulate as layers of pale siliceous ooze that harden into chert as they become buried under younger sediment. By around 200 million years ago (the end of Triassic time and the beginning of Jurassic time) this part of the ocean floor has moved close enough to the continent to start receiving significant amounts of muddy and sandy sediment washed in from the land. The cherts become increasingly muddy so that the sedimentary rock record changes from Triassic chert (200-250Ma) to Lower Jurassic siliceous mudstone (185-200Ma) and then to mudstone and sandstone (175-185Ma). These sediments together form the Fusaki Group. Then, around the beginning of Middle Jurassic time (175 Ma), all these Fusaki sediments begin to be subducted beneath the Eurasian plate.
3. As the sediments slide downwards they become scraped off their parent Pacific plate and stuck to the front of the overriding Eurasian plate to form part of a great wedge-like mass of rock called an “accretionary prism”. The accretionary prism is a very dynamic environment where frequent earthquakes result from the stresses built up as the two plates move against each other. Most rocks within the prism are relatively soft sediments and contain fluids which make them even weaker. Temperature and pressure slowly increase as the Fusaki sediments consolidate and become ruptured by fast earthquakes and slower shearing. The end result is tremendous disruption to form a mélange in which the original layering (or “rock stratigraphy”) is virtually destroyed, leaving smaller pieces and larger slabs of the harder rocks such as chert and sandstone immersed in a muddy matrix. This is the Fusaki mélange.
4. Sometime later the Tomaru blueschists rise back towards the surface and are placed against the Fusaki rocks by faults. These two units, both the product of oceanic plate subduction beneath a continent, but with one having been buried much deeper than the other, now form the old basement on which younger rocks will become deposited.
5. Time passes. The Pacific Plate continues to subduct, but the Tomuru/Fusaki basement is left alone at high levels in an old part of the accretionary prism until, in Eocene time around 40 million years ago, the area becomes volcanically active. The Tomuru/Fusaki basement subsides and becomes submerged beneath sea level as Miyara Group sands then coralline limestones are deposited before the eruption of the Nosoko andesitic volcanoes and the intrusion of the Omoto granitic pluton.
6. Another 20-25 million years or so pass with no rock record of events in the Ishigaki area. We are now in Miocene time and the geological setting of the Western Pacific has changed. The Pacific Plate has backed off from the continent to allow a new plate, the Philippine Sea Plate, to move north and subduct beneath this part of Eurasia. Thus Ishigaki finds itself sitting above the Philippine Sea Plate as part of an old accretionary prism produced long ago by Pacific Plate subduction. The sediments of the Yaeyama Group are deposited, mostly in shallow seas: by now the volcanic arc area lies further west so that the tectonic setting is one of a “forearc basin” between the arc and subducting Pacific Plate. Some of these forearc sediments will later be preserved as sedimentary rocks exposed on what will become the islands of Iriomote and Kohama.

7. The plate tectonic setting remains the same, with the Philippine Plate continuing its subduction up until the present day, currently sliding down beneath much of western Japan at the rate of 60-80mm/year to form the Kyushu-Ryukyu Arc (KRA). The KRA runs southwards from the large island of Kyushu in SW Japan for over 1000 kilometres to Ishigaki and Taiwan. In the Ishigaki area however the plate interaction is complicated by the fact that a large marine "backarc" basin, the Okinawa Trough, has been opening to the west of Okinawa between Kyushu and Taiwan.
8. The opening of the Okinawa Trough backarc basin, which in places is already 70 kilometres wide, forces the southern Ryukyu Islands to rotate clockwise. As a result, over the last million years or so Ishigaki has rotated 19^{o} from a more north-south to northeast-southwest orientation as the boundary between the Eurasian and Pacific plates in this area becomes increasingly east-west and Taiwan collides with mainland Asia. It is all a reminder of how active is the geology of the western Pacific, and how things can change (geologically) so quickly.
9. The increasing isolation of the southern Ryukyu Islands from the Eurasian continent as the Okinawa Trough widens means little continental sediment can mix with and disturb the abundant coral reefs surrounding the islands. These reefs have been producing limestone for something like one million years in Pleistocene and now Holocene time. These limestones are referred to as the Ryukyu Group.
10. As Ishigaki rotates, so the plate margin becomes more oblique. Instead of direct, head-on ("orthogonal") subduction seen in the north of the KRA, so the angle changes and a sideways (lateral) component of movement between the plates becomes more important. This lateral movement is taken up by faults, and it has been suggested that movement along these faults creating underwater rockslides is the main reason for the repeated great tsunamis known to have occurred in the southern Ryukyu Islands.
11. Radiocarbon ages obtained from reef boulders deposited by tsunamis suggest big events occur repeatedly. The most recent of these was the Great Meiwa Tsunami which occurred on the 24th April 1771 and had an estimated run-up of over 30 metres in places. The tsunami destroyed 8 villages, washed away 2,000 houses and left around 12,000 people dead or missing.

References for further reading

Goto, K., Miyagi, K., Kawamata, H., and Imamura, F. 2010. Discrimination of boulders deposited by tsunamis and storm waves at Ishigaki Island, Japan. Marine Geology, 269, 34-45.

Foster, H. 1965. Geology of Ishigaki-jima, Ryukyu-retto. The stratigraphy, the geologic history, and the regional relations of a small island in a western Pacific island arc. US Geological Survey Professional Paper, 339-A, United States Government Printing Office, Washington, A1-A119 pp.

Miyazaki, K., Ozaki, M., Saito, M., and Toshimitsu, S. 2016. The Kyushu-Ryukyu Arc. In: Moreno, T., Wallis, S., Kojima, T., and Gibbons, W. 2016. The Geology of Japan. Geological Society, London, 139-174.

Nakae, S. 2013. The radiolarian evidence for the accretion of the Fu-saki Formation with the inferred oceanic plate stratigraphy: A case of weakly-metamorphosed accretionary complex of Ishigaki Jima, southern Ryukyu Arc, Japan. J. of Asian Earth Science.

Nuong, N. D., Itaya, T., & Nishimura, Y. 2008. Age (K-Ar phengite)-temperature-structure relations: a case study from the Ishigaki HP schist belt, southern Ryukyu Arc, Japan. Geo. Magazine 145, 677-684.

Osozawa, S., and Wakabayashi, J. 2012. Exhumation of Triassic HP-LT rocks by upright extrusional domes and overlying detachment faults, Ishigaki-jima, Ryukyu islands. J. of Asian Earth Sciences, 59, 70-84.

Suzuki, A., Yokoyama, Y., Kan, H., Minoshima, K., Matsuzaki, H., Hamanaka, N., Kawahata, H. 2008. Identification of 1771 Meiwa Tsunami depositsusing a combination of radiocarbon dating and oxygen isotope microprofiling of emerged massive *Porites* boulders. Quaternary Geochronology 3, 226-234.

Background to Holiday Geology Guides

The author and geologist Wes Gibbons has always had an interest in writing short geoguides aimed at inquisitive tourists, offering them the opportunity to learn about the landscapes and rocks of scenically attractive places. His argument is that there is so much more to know about rocks and Earth history than the superficial descriptions offered by tourist guidebooks, which rarely even scratch the surface of Deep Time.

His first attempt in this direction produced *The Rocks of Sark* (1975), published jointly with John Renouf of Manche Technical Supplies in Jersey, a venture that taught a youthful Wes to always be the one responsible for the final proof reading. In 1976 Wes moved from Sark to begin a PhD supervised by Greg Power (Portsmouth University) and Tony Reedman (British Geological Survey). Living in a former Post Office in the village of Greatham on the Hampshire-West Sussex border, Wes decided to pass his spare time preparing a guide to the geology of the Weald in southeast England. He sold the idea to the publishers Allen and Unwin who commissioned other authors to develop a mini-series: *The Weald* (1981), *Snowdonia* (1981), *Lake District* (1982), and *Peak District* (1982).

His next field-based guidebook surfaced in 1985, fruit of several years research work in Corsica (*Corsican Geology: a field guidebook* by Wes Gibbons and Jana Horák). Two years later Wes launched the Holiday Geology series, using a simple, inexpensive format later described as “a single A3 laminated sheet …. folded into three and (with).. six portrait panels … filled with a lively mix of colour photos, maps, sections and text” (review by Nigel Woodcock in Geological Magazine, 2000). The first two Holiday Geology guides were *Scenery and Geology around Beer and Seaton* (Wes Gibbons 1987) and *Rocks and Fossils around Lyme Regis* (Wes Gibbons 1988). The Holiday Geology concept attracted the attention of the British Geological Survey who went on to expand the series to over 20 titles.

Following his retirement in 2004 to live in Barcelona with Teresa Moreno, Wes maintained his interest in publishing field guides by writing the text to *Field Excursion from Central Chile to the Atacama Desert* (Gibbons and Moreno 2007), *The Geology of Barcelona: an Urban Excursion Guide* (Gibbons and Moreno 2012), and *Field Geotraverse, Geoparks and Geomuseums* (in central and southwest Japan: Gibbons, Moreno and Kojima 2016). His most recent publishing project, the most ambitious so far aimed at a general readership, has produced the book *Barcelona Time Traveller: Twelve Tales* (2016, Spanish translation 2017: Bimón Press Barcelona) and the resurgence of the Holiday Geology concept, although this time in virtual format linked to the *Barcelona Time Traveller* webpage.